VOL. 121 October, 1957 NO. 4

MILITARY MEDICINE

ORIGINAL ARTICLES

Authors alone are responsible for opinions expressed in their contributions

Studies in Wound Ballistics: Temporary Cavity Effects in Soft Tissues

By

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(With eight illustrations)

THE development of weapons, primarily for military use, which are capable of ejecting projectiles at velocities ranging upward from about 2,000 feet per second, introduced a new and for many years puzzling feature into missile-produced war wounds. This is the so-called "explosive effect" of high velocity projectiles. Missiles in this category include shell, bomb and grenade fragments as well as bullets. Military surgeons have long been familiar with the often bizarre effects of such missiles on the human body. For example, a small shell fragment or bomb splinter of seemingly insignificant size which produces but a minute wound of entrance in the skin may create relatively great havoc internally. It is of interest to note in this connection that during the first World War charges and countercharges were frequently made by the belligerents that enemy soldiers were using dumdum, expanding soft-nose and explosive bullets. Actually, authentic instances of the use of such bullets in this war were comparatively rare. Wounds which were often attributed to deforming or exploding bullets were in most cases produced either by ordinary bullets or by fragments whose distinguishing characteristic was their high impact velocity.[1]

Early experimental studies of wound ballistics were prompted by the adoption by the armies of various nations of the breech-loading magazine rifle. Continuing interest in the mechanisms of wounding by high velocity missiles has been maintained both by clinical and post-mortem observations of battle wounds during the succession of wars of the past 85 years, and by experimental investigations, which for the most part have been either conducted by or sponsored by the military services. References to the older literature on wound ballistics (prior to about 1940) can be found in Wilson,[1] Callender and French,[2] Callender,[3] Harvey et al.[4] and Herget.[5]

The modern era in wound ballistics can be considered to have begun with the work of Black, Burns and Zuckerman[6] in which a spark shadowgraph method was used to obtain photographs of gelatin blocks and animal parts at time intervals measured in microseconds after missile impact. The shadowgraphs obtained by these authors showed that both gelatin blocks and muscle masses undergo expansion—up to 3 to 4 times the original volume in the case of gelatin blocks—followed by a return to the

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original size within a few milliseconds after passage of a small steel ball at velocities up to about 3,300 feet per second. Pictures taken at intervals of 100 microseconds or so showed intermediate stages in the process of expansion and collapse. The results were interpreted as being due to the explosive formation of a cavity within the target material.

Definitive evidence for the formation in tissue as well as in other semi-solid media of a transient cavity of relatively large volume and a lifetime of but a few milliseconds following passage of a high velocity missile has subsequently been obtained by the use of high speed motion pictures and microsecond exposure roentgenograms. The Westinghouse "Micronex" apparatus[7] produces a pulse of predominantly hard x-rays of approximately 1 microsecond duration. Micronex discharge can be timed to occur at any desired instant within a microsecond or two following impact of a projectile on a target by means of appropriate instrumentation. Much of the groundwork utilizing these new methods was accomplished by Harvey and his coworkers at Princeton during World War II. Results of the wartime work done by the Princeton group have been summarized by Harvey et al.[4] In brief, the development and decay of a relatively large temporary cavity whose lifetime is of the order of 5 to 10 milliseconds, was found to be the most striking event to occur in various media, including water, gelatin blocks and animal tissue, following passage of a high velocity missile. The temporary cavity generally attains its maximum volume within 2 to 4 milliseconds after missile impact and then undergoes several pulsations as it subsides. At the moment of missile impact a shock wave with the velocity of sound in the particular medium and a peak pressure of several hundred psi is produced. Harvey et al., however, consider that this shock wave does not contribute significantly to the damage produced by a high speed missile, primarily because very little if any displacement accompanies it. The rapid radial displacement of the medium which occurs as the temporary cavity forms is thought to be of greater importance in this connection. In experiments in which small steel spheres were fired at high velocity into the heads of cats and dogs, Butler, Puckett, Harvey and McMillen[8] obtained microsecond roentgenograms of the temporary cavity in the brain. These pictures reveal great displacement of tissue and extensive fracturing of the skull caused by spheres of ¼ inch diameter.

The question of the nature and extent of damage to various kinds of tissues which might be attributable solely to temporary cavity formation remains to be resolved. Considerable evidence is available to show that a long bone such as the femur may be fractured even though it is not struck directly by a high velocity missile which penetrates the surrounding muscle. Elastic structures such as larger blood vessels and nerves appear grossly at least to be relatively unharmed if not directly hit.[4] In the case of nerves, however, it has been shown that functional damage can result from the passage of a high velocity missile that did not strike the nerve directly.[9,10,11] Impairment of conduction in the sciatic nerve of cats was shown by Puckett et al.[11] to result from near misses of high velocity missiles, when as revealed by microsecond roentgenograms, the nerve was rapidly blown aside during expansion of the temporary cavity.

Temporary cavity effects in muscle

It has not been demonstrated that striated muscle fibers are significantly damaged merely by displacement accompanying temporary cavity formation. Harvey et al.[4] suggested that in vascularized tissue such as muscle, a region of serious damage surrounding a permanent wound tract coincides with a zone in which extravasated blood occurs. Conventional histological preparations of muscle fibers adjacent to a permanent wound caused by a high velocity missile afford only inconclusive evidence in this connection. Such evidence as can be gleaned from ordinary histological sections of wounded muscle, where fixation is accomplished before possible secondary changes

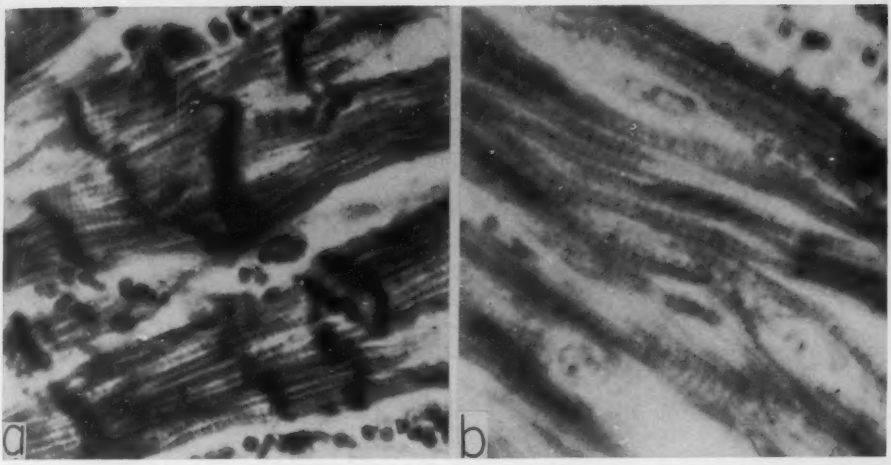

FIG. 1. Sections of goat skeletal muscle near edge of a wound tract from samples cut within 1 hour after wounding. (a) Prominent retraction clots in fibers among which are free erythrocytes. (b) Free erythrocytes among fibers in which no retraction clots or other obvious signs of injury are apparent. Magnification 750×.

have become manifest, do not necessarily support this view. A conspicuous response of striated muscle fibers even to mild injury is the immediate formation of retraction clots.[12, 13] Figure 1a is a photomicrograph of a section of goat skeletal muscle adjacent to a wound produced by a high velocity missile. Prominent retraction clots are present in the fibers. It is by no means difficult, however, to find areas near a wound tract in muscle in which free blood cells are present among the fibers in which no retraction clots or other microscopically apparent evidence of injury is visible as in figure 1b.

It is possible, of course, that even irreversible injury to muscle fibers may not be microscopically visible immediately following wounding. It would be difficult, however, to determine whether delayed pathological changes exhibited by muscle fibers near a wound were a consequence only of physical trauma sustained by the fibers directly or whether they might not be at least in part a secondary response to impaired blood supply.

In an effort to ascertain whether fibers at a distance from a permanent cavity produced by a high velocity bullet in muscle might have sustained some damage to their sub-microscopic micellar or even molecular organization, the present author[14] has used a photometric method to measure changes in the optical retardation of suitably prepared samples of doubly refractive striated muscle fibers obtained from wounded goat muscles. In rectus femoris muscles which were fixed *in situ* by formalin perfusion within 1 hour after being shot by .30 caliber armor-piercing rifle bullets at impact velocities of approximately 2,800 feet per second, there was a significant decrease, as compared with unwounded muscles, in the value of the optical retardation of samples taken from within about 1 cm. of the edge of the permanent cavity. Microsecond x-ray pictures of the temporary cavities in these muscles indicated that fibers at the edge of the permanent cavity had undergone displacement of up to 3 cm. The decreases in optical retardation noted in these cases, however, were no greater than decreases observed in the optical retardation of comparable samples taken from the same distance from the edge of a knife wound. Photographic evidence is available to show that no explosive temporary cavity formation follows a knife thrust into muscle.[15]

It would appear that changes in the optical

properties of muscle fiber samples, which could be detected and measured by the method used in these experiments, were due mainly to shortening of the fibers rather than to a specific effect of temporary cavity formation. This method, however, did not resolve changes in individual fibers. Investigations are currently underway in which individual myofibrils from wounded and normal muscle are being studied in ultrathin sections with the electron microscope.

Relation of Temporary Cavity Size to Permanent Cavity Size in Soft Tissues

Although questions concerning the nature and extent of immediate damage to muscle fibers resulting from temporary cavity formation remain unanswered, subsequent degenerative changes are well known to occur in traumatized muscle and other soft tissues. Such changes are abundantly described in the literature of pathology.[16] In the surgical treatment of high velocity missile wounds it is considered necessary to excise irreversibly damaged tissue.[17,18] Early recognition of irreversibly damaged or non-viable tissue may be quite difficult without recourse to specialized methods such as vital dye staining[19] or fluorescence microscopy.[20] Methods such as these, however, are applicable only in a laboratory situation. On the other hand, the physical dimensions of a high velocity missile wound may be determined with sufficient accuracy during the course of surgical exploration to be useful in evaluation of the possible extent of damaged tissue if the causative missile can be identified. It should be pointed out in this connection that it is rarely, if ever, possible to derive the velocity of the causative missile from information available on the battlefield.

In studies carried on in this laboratory an attempt has been made to establish an empirical relation between the size of the permanent cavity produced by stable, high velocity rifle bullets in soft tissues and the size of the associated temporary cavity. It is necessarily assumed that temporary cavity formation contributes in some way to cell and tissue damage, even if only indirectly through enlarging the area of vascular disruption or in causing impairment of conduction in nerves. It was found that under the experimental conditions employed, the size of the permanent cavity affords a basis for approximating within reasonable limits the size of the associated temporary cavity. A brief presentation of the methods used and of the results obtained in these studies is presented in the following sections.

Determination of Permanent and Temporary Cavity Dimensions and Volume

For the most part, excised goat rectus femoris muscles and livers were used in these experiments, although a few muscles and livers were shot *in situ*. A single wound was made in each muscle and liver using .30 caliber, armor-piercing rifle bullets with impact velocities of approximately 1,400, 2,800 and 4,200 feet per second. Details of the experimental procedures and instrumentation are presented elsewhere.[21] The bullets were stable in air at each velocity and did not tumble or wobble significantly in the muscles or livers, which varied in thickness from 3.3 to 4.5 cm. A microsecond roentgenogram of the maximally expanded temporary cavity was obtained in each case with the exception of some of the *in situ* shots. The time after impact at which the temporary cavity would be maximally expanded was determined in muscles and livers separately at each velocity by a preliminary series of shots in which the x-ray discharge was initiated at intervals of 200 to 400 microseconds over a range of from 600 to 4,200 microseconds following bullet impact.

Immediately following wounding a thermo-setting, cold-pouring plastic* was introduced into the permanent cavities where it was allowed to harden at room temperature. Polymerization was hastened by the addition of a catalyst to the plastic. Care was taken to disturb the wounds as little as possible during this procedure. Volume change of the

* Distributed by the General Biological Supply House, Chicago, Ill.

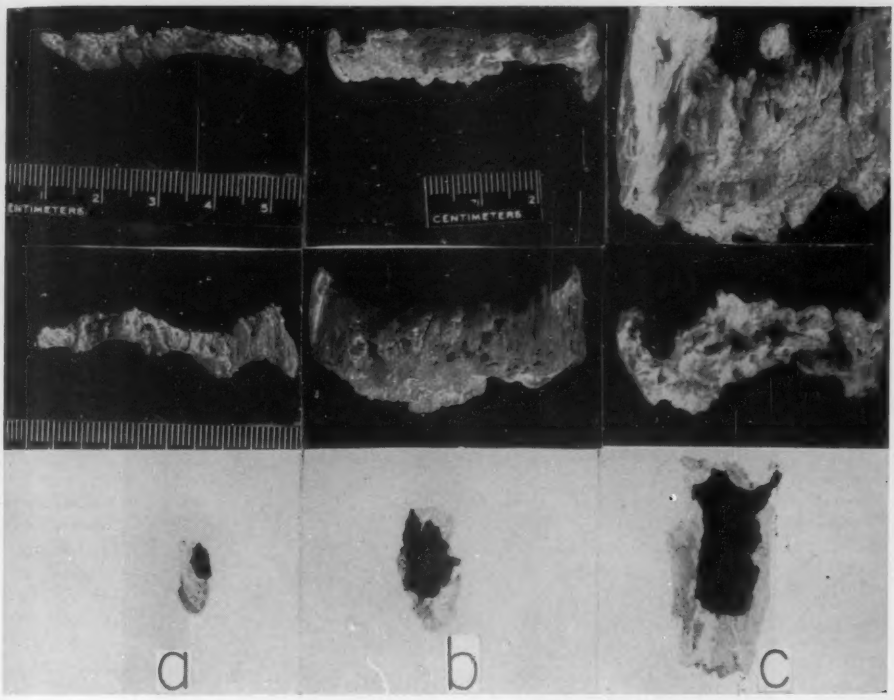

FIG. 2. Representative plastic castings of permanent wounds in excised goat rectus femoris muscles made by .30 caliber AP bullets at various velocities. From top to bottom each group, identified by the letters *a*, *b* and *c*, consists of 2 lateral views at 90° to each other and a cross-section. In each case the direction of bullet flight was from right to left. All of the pictures are to the scale shown. (a) 1400 ft. per sec. (b) 2800 ft. per sec. (c) 4200 ft. per sec.

plastic accompanying polymerization was found to be less than 1 per cent and polymerization occurred without appreciable bubble formation. After the plastic had hardened thoroughly in a wound, the surrounding tissue was trimmed away and the casting was soaked in NaOH solution to facilitate removal of remaining adherent tissue.

Surface and cross-section views of representative plastic castings of permanent wound cavities in isolated muscles and livers made at different bullet velocities are shown in figures 2 and 3 respectively. Permanent cavities, as represented by these castings, tend to be somewhat irregular in outline and frequently are laterally compressed, especially in isolated muscles. Approximately the mid-level of each casting was selected for representation of the cross-section. It is obvious from the pictures that the dimensions of a cross-section may vary considerably with the level selected.

The volume of the plastic castings was determined initially by displacement. Later, when an adequate value for the density of the polymerized plastic was available, the volume of individual castings was calculated from their weight.

The area of the selected cross-sections was obtained by tracing their outline with a polar planimeter. An average diameter of the permanent cavity was then taken to be equal to the diameter of a circle of area equal to that of the cross-section of the casting.

Temporary cavities in both excised muscles and livers, viewed in lateral aspect in microsecond roentgenograms (figures 4 and

5) appear in general to be more regular in outline than do the permanent cavities as represented by plastic castings. So-called "end-effects," which are manifested as distortions of the cavity outline at either end, are usually observed in the roentgenograms. End-on microsecond roentgenograms, such as those shown in figure 6, demonstrate that

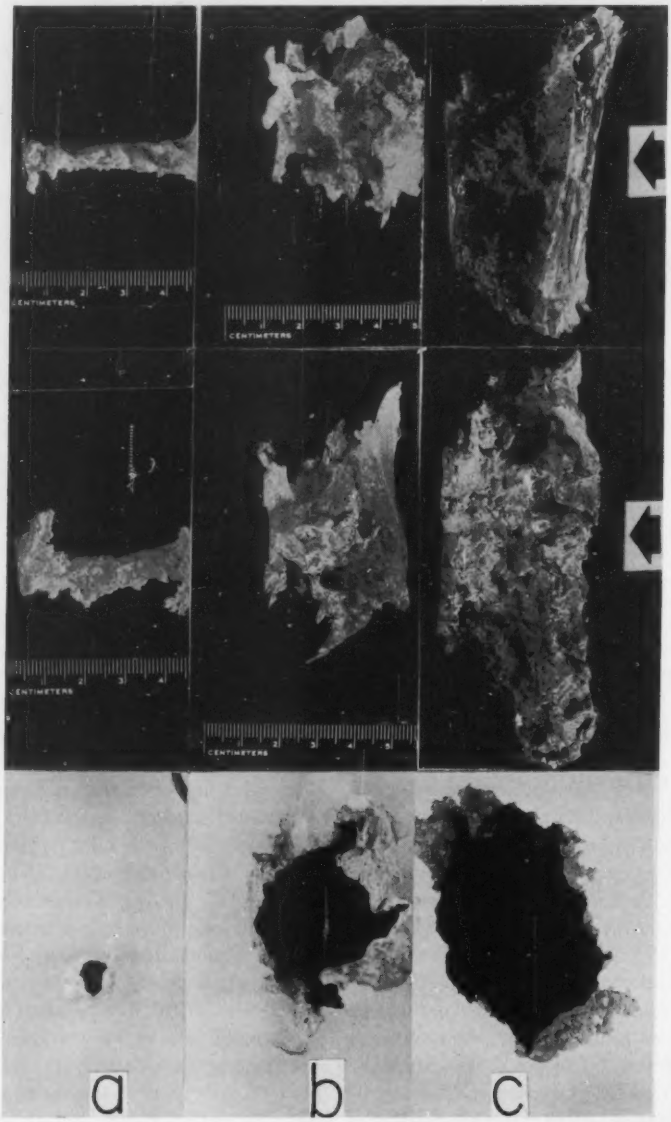

FIG. 3. Representative plastic castings of permanent wounds in excised goat livers made by .30 caliber AP bullets at various velocities. Arrangement of groups as in fig. 2. The direction of bullet flight was from right to left and the scale of all pictures is as shown. (a) 1400 ft. per sec. (b) 2800 ft. per sec. (c) 4200 ft. per sec.

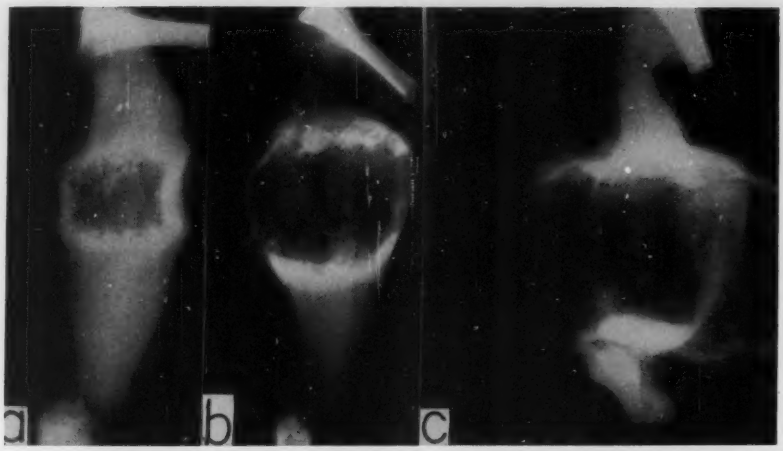

FIG. 4. Microsecond roentgenograms of representative, maximally expanded temporary cavities made in excised goat rectus femoris muscles by .30 caliber AP bullets at various velocities, viewed in lateral aspect. The direction of bullet flight was from right to left. (a) 1400 ft. per sec. (b) 2800 ft. per sec. (c) 4200 ft. per sec.

the temporary cavities in isolated muscle and liver tend to be circular in cross-section.

The dimensions and volume of temporary cavities were determined from tracings of microsecond roentgenograms of the cavities viewed in lateral aspect. An automatic integrating device was used to obtain the volume. The diameter of the temporary cavities was measured at the midpoint of the longitudinal axis of the tracings and perpendicular to this axis.

COMPARISON OF PERMANENT AND TEMPORARY CAVITIES IN EXCISED MUSCLES AND LIVERS

Mean values and standard deviations of the volume and diameter of permanent and temporary cavities produced in excised rec-

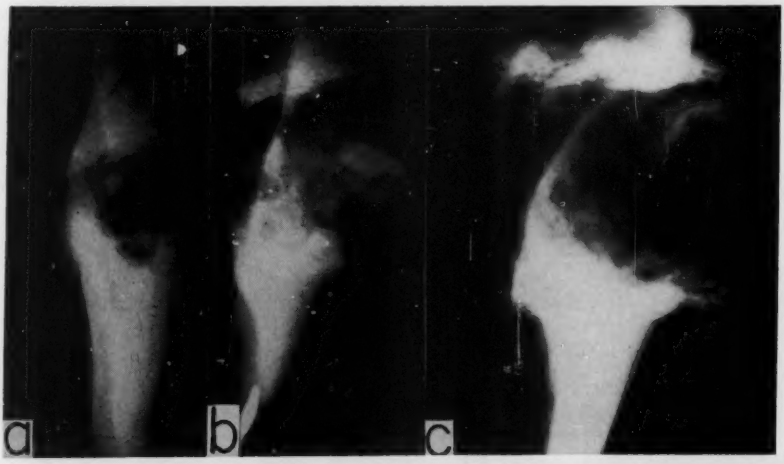

FIG. 5. Microsecond roentgenograms of representative, maximally expanded temporary cavities made in excised goat livers by .30 caliber AP bullets at various velocities, viewed in lateral aspect. The direction of bullet flight was from right to left. (a) 1400 ft. per sec. (b) 2800 ft. per sec. (c) 4200 ft. per sec.

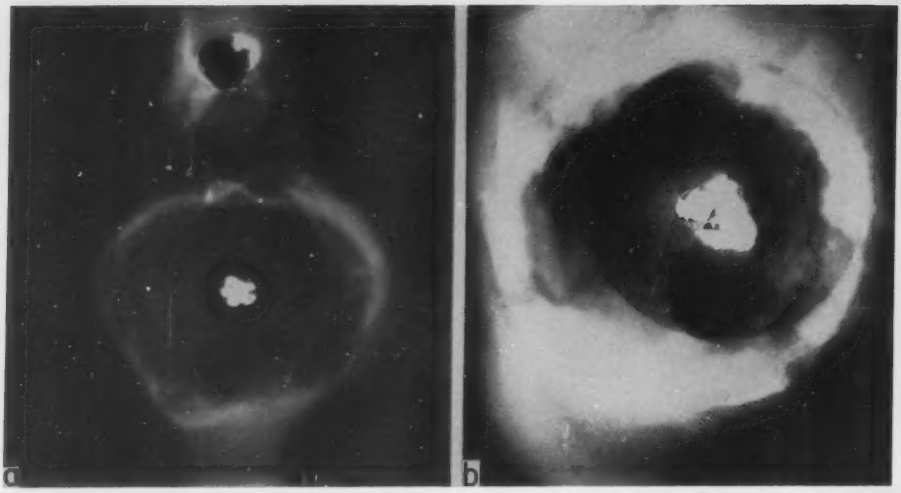

FIG. 6. Microsecond roentgenograms showing nearly end-on views of maximally expanded temporary cavities made by .30 caliber AP bullets at 2800 ft. per sec. (a) Cavity in excised goat rectus femoris muscle. (b) Cavity in excised goat liver.

tus femoris muscles and livers by .30 caliber armor-piercing bullets at various impact velocities are shown in Table I. The ratios of mean temporary cavity volume and diameter to mean permanent cavity volume and diameter are also shown in the table. It should be noted that the rectus femoris muscles were shot in either of two orientations with respect to the bullet path. These were: (1) bullet path parallel to the central septum of the muscle, (2) bullet path perpendicular to the central septum of the muscle. The orientation of the rectus femoris was found to influence the size of the permanent and temporary cavities, although factors other than the central septum and arrangement of

TABLE I

MEAN VOLUME AND DIAMETER OF PERMANENT AND TEMPORARY CAVITIES PRODUCED IN EXCISED MUSCLES AND LIVERS BY .30 CALIBER ARMOR-PIERCING BULLETS AT DIFFERENT VELOCITIES

Target	No. of wounds	Mean bullet impact velocity in ft/sec	Permanent cavity				Temporary cavity				Ratio, temp. cavity / perm. cavity	
			Volume (cc)		Diameter (cm)		Volume (cc)		Diameter (cm)			
			Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Vol.	Diam.
Muscle∥*	10	1363	0.7	0.23	0.6	0.07	30	13	3.0	0.57	49	5
Muscle⊥†	10	1363	0.6	0.16	0.7	0.19	31	9.3	3.4	0.26	46	4.9
Liver	5	1363	3.4	0.98	1.0	0.35	52	9.9	4.0	0.68	16	4
Muscle∥	10	2785	2.7	0.65	1.0	0.13	116	34	4.9	0.32	45	4.9
Muscle⊥	10	2785	1.3	0.35	0.8	0.13	96	25	5.6	0.42	80	7
Liver	5	2785	30	9.0	2.6	0.63	198	69	6.1	0.63	6.9	2.3
Muscle∥	8	4196	14	4.8	2.2	0.44	320	54	6.8	0.75	23	4
Muscle⊥	6	4196	5.2	1.5	1.7	0.27	251	47	6.6	0.80	52	3.9
Liver	5	4196	65	16	4.8	0.43	708	106	9.6	0.48	12	2

* Muscle shot parallel to the central septum.

† Muscle shot perpendicular to the central septum.

muscle fiber bundles must be taken into account in interpreting the results. In this connection it is of interest to compare the energy absorption in muscles and livers at the different bullet velocities.* It was found that the energy absorption per cm of tissue traversed is essentially the same in muscle and liver. The two kinds of tissue have very nearly the same density.[22] Other factors, consequently, must account for the observed large differences in both permanent and temporary cavity size. It can be shown that variations in target dimensions of the magnitude encountered in the present experiments cannot account for the differences in cavity size. It seems safe to say, therefore, that the observed differences are a manifestation of more fundamental differences in the structural and mechanical properties of muscle and liver.

The cross-sectional diameter of the temporary cavity is a direct measure of the distance through which tissue components are displaced as the cavity expands. For this reason it is of particular interest to relate the diameter of a temporary cavity to that of the associated permanent cavity. In figures 7 and 8 the diameter of temporary cavities in excised muscles and livers respectively is shown as a function of the permanent cavity diameter. It can be seen from the figures that the range of temporary cavity diameters is somewhat greater in muscles than in livers even where the permanent cavities are of comparable diameter. This may be an additional manifestation of differences between these tissues.

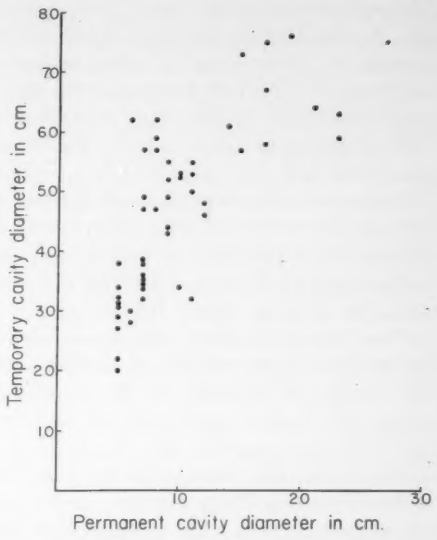

FIG. 7. Diameter of temporary cavities vs. diameter of permanent cavities made in excised goat rectus femoris muscles by .30 caliber AP bullets at various velocities.

Under field conditions one would not encounter wounds caused by rifle bullets having an impact velocity greater than the muzzle velocity of standard rounds, which is approximately 2,800 feet per second in the case of .30 caliber armor-piercing and ball

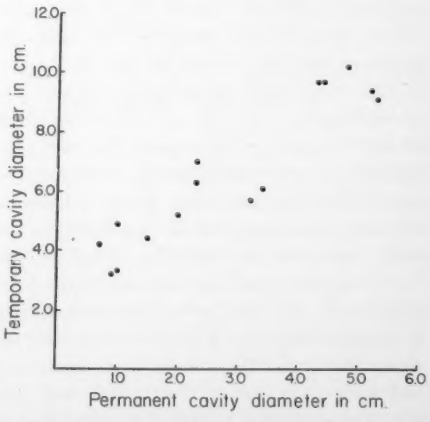

FIG. 8. Diameter of temporary cavities vs. diameter of permanent cavities made in excised goat livers by .30 caliber AP bullets at various velocities.

* Energy absorbed (in foot pounds) $= \frac{W(V_o^2 - V_r^2)}{2g}$,

where W = weight of bullet in lbs., V_o = initial velocity, V_r = residual velocity, g = acceleration of gravity. Although energy loss in semi-solid media such as tissue is probably exponential, in the special case considered here, in which the targets are of fairly uniform, small thickness and loss of bullet energy is small in relation to the total kinetic energy of the bullets, dividing total energy absorbed by the length of the bullet path in cm gives an average value which is a close approximation to the true instantaneous energy absorption.

ammunition used by the United States Army. In all probability the majority of rifle bullet wounds would be made by bullets with diminished velocity. For this reason, the most significant values of temporary cavity diameters displayed in figures 6 and 7 are those associated with permanent cavities whose diameter is in the range of about .5 cm to a little more than 1 cm. The majority of these wounds were produced by bullets with an impact velocity of about 1,400 feet per second. In excised rectus femoris muscles, without regard to their orientation, where the diameter of the permanent cavities is in this range, the diameter of the associated temporary cavities was found to be from about 2 cm to approximately 6 cm. In excised livers, the corresponding range of temporary cavity diameters was found to be from about 3 cm to 5 cm, although it should be noted that only 4 of the total number of liver wounds fall in this restricted category.

Significance of the Results of Experiments with Excised Muscles and Livers

The results of experiments with excised muscles and livers demonstrate that an empirical relation can be established between the size of the permanent cavity and that of the associated temporary cavity in an excised soft tissue mass produced by a stable, nontumbling bullet of a given shape at a particular velocity. The present data, although pertinent only to a specific set of experimental conditions, nevertheless suggest the possibility that further investigations along similar lines might be expected to yield results of broader applicability. It should be noted, however, that data which pertain to excised organs may not be applicable to the same structures *in situ* in the living animal. A few experiments in which the rectus femoris muscle and the liver were shot *in situ* in anesthetized, immobilized animals, did indicate that under these conditions permanent and temporary cavity dimensions and volume are somewhat modified as compared to those of wounds produced in the excised organs. The same general relation between cavity size and bullet velocity as observed with excised muscles and livers appeared, however, to hold in the case of wounds produced *in situ* under the conditions of the present experiments. It is not improbable that this is also true in the case of an active animal with freedom of movement. The present results, however, in no way suggest that the dimensions or volume of a given permanent cavity produced in a soft tissue by a high velocity projectile are sufficient under any circumstances to define precisely the corresponding dimensions or the volume of the associated temporary cavity. Statements have appeared in the literature which imply that there is a constant relation between the cross-section diameter of temporary cavities and the cross-section diameter of the associated permanent cavities.[23, 24] Such statements should not be accepted as of general validity, although unfortunately an inference to this effect tends to be perpetuated. What can be stated on the basis of the present results is that it is possible to establish a range within which a majority of the values for the diameters and volumes of the temporary and permanent cavities produced by a given missile in a given soft tissue under expressly defined conditions might be expected to occur. There is no reason to suppose that this could not be accomplished for wounds in whole, living animals, provided the rather formidable technical difficulties could be overcome.

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Some Problems: Influenza

(Extracted from article *Military Surgeon*, Vol. 59, p. 284, Sept. 1926.)

By
F. G. Crookshank, M.D., F.R.C.P.

The Periodicity of Influenza

AT THE very foundation of the doctrine of the epidemic constitution lies an observed fact, implicitly or overtly recognized by Hippocrates, by Baillou, and by Sydenham. It is this: that epidemic catarrhal prevalences, and prevalences of the nervous kind now familiar to us as encephalitis lethargica, as poliomyelitis, and the like, have always, though irregularly, tended to be chiefly manifest about the times of the equinoxes, and, more particularly, somewhat *before* the vernal equinox—now the twenty-first of March, and *after* the autumnal equinox—now the twenty-third of September.

Certainly there are eccentric variations, but the generalization holds true, and there is a seasonal incidence, of the kind indicated, in all years.

Now, several years ago, it was suggested by Brownlee—not as a result of historical study, but from investigation of mortality returns from London and certain great towns during recent years—that there is, in any year, a thirty-three week periodicity in respect of influenzal prevalence with the peculiarity that, when an epidemic falls due between the middle of June and the beginning of November, it does not normally occur, and the maximal incidence is, in any case, between January and May (*Lancet:* 1919, ii, 856, and 1923, i, 1116). Brownlee's conclusions have been persistently supported by the medical correspondent of *The Times*, but destructively handled by Spear, who declares that the alleged thirty-three week periodicity has no existence in fact (*Lancet:* 1920, i, 589). The truth seems to be that Brownlee has merely re-stated, with the apparent but oftentimes fallacious precision of modern statistics, the older generalization that these prevalences commonly occur in the late winter *before* the vernal equinox and, though less frequently, *after* the autumnal equinox. In any case, they are most prone to occur about the times of the equinoxes. This seasonal periodicity, thus stated, at once correlates the prevalences with "telluric and cosmic influences." But there is more to be said. In some Charwick Lectures given in 1918, I showed, cartographically, from an historical study of the recorded catarrhal and nervous influenzas during four hundred and fifty years, that there is a definite tendency for influenza to appear in epidemic form every ten or eleven years, and a clearly marked though irregular tendency for greater prevalences or pandemics to occur about thrice in a century, or once in every thirty-three years. It would perhaps be more correct to say that, although the manifestations are variable, eleven-year and thirty-three-year periods can be distinguished. Now Stallybrass, in a paper supporting Brownlee's thirty-three week hypothesis, has found evidence of a decennial periodicity as shown by mortality statics, and his suggestion has apparently been endorsed (*Lancet:* i, 139, 372). Stallybrass' decennial periodicity nearly coincides with the eleven-year rhythm that I think historical investigation demonstrates, but, while Brownlee and Stallybrass only deal with death rates in respect of the *respiratory* forms of influenza, my own conclusions are based upon epidemiological records, while, with the great majority of epidemiologists, I consider the *nervous* prevalences to be a part of influenza and to represent the "other side" of the *catarrhal* epidemics (*Franco-British Medical Review*, November, 1924).

I suggest, then, that there is at any rate a *prima facie* case for postulating (1) a seasonal or pre-vernal and post-autumnal equi-

noctial periodicity; (2) a ten-or eleven-year periodicity; and (3) a thirty-three year periodicity, of prevalences, epidemics and pandemics respectively of what we may call catarrhal and nervous influenza.

Telluric and Cosmic Influences

If, noting these suggestions, we inquire whether or no there is any evidence of correlation between influenzal prevalences and cosmic or telluric influences, we are at first met with a blank wall. In the very remarkable "Report on Influenza," issued by the Ministry of Health in 1921, it is stated with the greatest assurance that we may have "complete confidence that the cruder generalizations of the older hypotheses are unsound and that the part played by the meteorological peculiarities of the pandemic years was a minor one" (loc. cit., pp. 150-162). We are also told that the negative result of exploration of the events of the year 1918 absolves us from need of discussing the telluric theories of Boyle, Arbuthnot and Creighton.

Nothing could be less adequate to the occasion, however, for the explorations conducted by the Ministry into the events of 1918 do not appear to have taken note of the phenomena of atmospheric pressure and magnetic disturbances. To the former subject Dr. C. M. Richter, of San Francisco, has devoted years of study, and his series of papers has been completed by a monograph that appeared in the *Archives of Internal Medicine* for March, 1921. Richter has studied the question, not merely in terms of special localities and epidemics, but in those of continents and cycles of years, and has definitely established that there is correlation between the pandemic periodicity of influenza and cyclic variation in air-pressure, so that, broadly speaking, pandemic and epidemic influenza corresponds with general and local high air-pressure (or anti-cyclonic conditions) and inter-pandemic and epidemic quiescence with low air-pressure conditions. Moreover he declares, and rightly, that while influenzal and pneumonic epidemics and pandemics are a *function* of anti-cyclonic weather values (only developing during high-pressure periods), the cyclic variations of high- and low-pressure periods harmonize with, and are apparently caused by, cyclic changes in solar activities.

Pace the Ministry of Health, then, there is at least a *prima facie* case in favor of some "cruder generalizations of the older hypotheses."

But can the matter be pursued farther? Yes: if, that is, we care to have recourse to such not very recondite works as *Whitaker's Almanac* (The Earth: Solar System, etc.) and the Encyclopedia Britannica (Climate and Climatology, pp. 525, 526, and Magnetism, Terrestrial, pp. 376, 377, 378).

We there find that, while there is a connection between the solar activity (as shown by the sun spots) and terrestrial magnetism (for the coincidence in time is too marked to be fortuitous), the cyclic variation in respect of terrestrial magnetism and sunspots, as scientifically determined, correspond very closely with the periodicities and rhythms of influenza, as revealed by epidemiological and historical research, and as stated above.

To be more precise, Mander has shown that, if the year be divided into three seasons—Winter, from November to February; Summer, from May to August; and Equinox, made up of March, April, September, and October—the maximal disturbances of terrestrial magnetism occur *during the equinoctial season with a tendency to precede the vernal and follow the autumnal equinox*. In other words, the magnetic periodicity is that determined for influenza by Hippocrates, Baillou and Sydenham, and indirectly supported by Brownlee and Stallybrass.

We find, moreover, that, while the seasonal correspondence thus holds good, for influenza, for terrestrial magnetism, and for sunspot activity, there is a definite eleven-year periodicity in respect of the last two series of phenomena which corresponds exactly with what I have suggested for influenza and, very closely, with the ten-yearly influenzal periodicity of Stallybrass.

Nor is this all. Brückner, of Berne, has

established a long period climatic oscillation, known as the Brückner cycle, of which the length is approximately thirty-five years, that obviously coincides with Lockyer's thirty-five year cyclic variation in solar activities. The correspondence with the suggested thirty-three-year rhythm of pandemic influenza needs no emphasis, but it should be remembered that E. Richter has found like cycles in the movements of Swiss glaciers, and that the thirty-three-year periodicity of influenza has received such recognition that some epidemiologists have tried to explain it in terms of generations of immunity amongst the population of the world.

Again, it is interesting to observe that the air-pressure variations shown by Richter (of San Francisco) seem to follow the same cyclic necessities, while, just as I noted some time ago that sometimes one influenzal cycle seems to merge into another, so has Brückner declared that his cycles do merge or overlap.

Lest all this should seem merely fanciful, some particular references may be made to recent work. Vallot, Sardou, and Faure, in a communication made to the French Academy of Medicine on July 11, 1922, showed definite correlation to exist between sunspot activity and periods of acute physical disturbance in chronic invalids. The relation between sunspot activity and terrestrial magnetic disturbance was insisted on by Cortie at the Toronto (1924) meeting of the British Association; and Sir Richard Gregory, only the other day, when speaking on the same subject, drew attention to the sunspot activity of 1917. This was the year that gave birth to the last great pandemic influenza, to so much poliomyelitis in America, and to encephalitis lethargica in Austria and elsewhere. Moveux, of the Bourges Observatory, is confident as to the correlation between sunspots and individual and national disturbances of health—physical and mental: predicting renewed disturbances in 1928, when the present sunspot period will culminate. This will be just eleven years from the commencement of the great influenzal disturbances of which the echoes have not yet died away, and which seem, indeed, to be gaining in strength.

Our own Meterological Office issued, in 1923, a Report dealing with variations in the levels of the great African lakes, wherein was emphasized the general correlation between telluric and cosmic changes and disturbances—a subject discussed at greater length by Huntington, of Yale, in his recent work on "Earth and Sun." Huntington introduces some considerations of enormous epidemiological interest, as when he shows that barometric gradients over the North Atlantic respond in *different and opposed ways* to sunspots on two sides of the sun's equator. These and other facts seem to show that, as had already been suspected, there is no *simple effect* on terrestrial conditions of solar activities, but, as it were, reaction, or response, that is compensatory, in great part at least, for direct effects. So that we can form some idea of peculiar disturbances arising when this compensation is imperfect or is interfered with by other influences. Again, within the last few days, the adjudicators for the Adams Prize, at Cambridge, have propounded as a subject for discussion in 1925-26 the question "as to how far the various suspected periodicities of earthquake phenomena, if real, must be attributed to the periodocity of external agents, and how far, if at all, they represent periodicities of free vibrations of the earth itself." Truly, this is a harking back with a vengeance to the "cruder generalizations of the older hypotheses"! For no notion was more familiar to the great thinkers of bygone days than that of the interdependence of conditions of terrestrial life and changes in the physical condition of the earth and the sun, as revealed by earthquakes, eruptions, storms, and the like.

Indeed, there are only too many evidences of the dependence of the rhythm of all living creatures—men, and even microbes—upon the rhythm and changes of the earth and the sun and the other elements of the cosmos.

Sir Arthur Shipley has shown how a sea urchin in the Red Sea "keeps time" with

the moon's phases (*Lancet:* 1923, i, 479), and Hopkins, of the United States Bureau of Entomology, has formulated a "bioclimatic law" that expresses the response of insect life to climatic conditions. Butler, speaking to the Association of Economic Biologists on November 18, 1921, did much the same in respect of plants and fungi, while, in the *Lancet,* for March 3, 1923, is an interesting note upon the changes in physiological functions that, even in the laboratory, are found to be correlated with seasonal phenomena. One thing at least is clear. If we take heed of the despised "telluric and cosmic influences" inferred by the older writers and demonstrated by scientific observation in these latter days, we are not thereby under the necessity of dispensing with bacteriological research. Far from it: we may, perhaps, come to a better understanding of those relations between man and the microbe that, too often, are expressed in terms of plague and pestilence. That is, however, another story. In the meantime, need we hesitate to endorse, with Theophilus Thompson, and in respect of influenza, some of the "cruder generalizations of the older hypotheses," and to say that, "where we cannot detect relations of cause and effect, we may yet obtain a glimpse of truth in the study of concurrent series of phenomena?"

Influenza

From the Council on Public Health, American College of Chest Physicians

INFLUENZA epidemics in the Orient, which have been reported in the press during the past few weeks, are being watched with concern by public health authorities in the United States and in other parts of the world. The first outbreak reported was in Hong Kong, and it was followed by others in Singapore, Formosa, the Philippine Islands, and other countries in the Far East, as well as in American military personnel stationed there and on ships returning to the United States.

The illness reported has in most cases been mild, characterized by fever, malaise, headache, mild respiratory symptoms, and a dry cough. Usual duration has been 2 or 3 days, few complications have been reported, and case fatality has been low. Attack rates, however, have been high—in some areas, as high as 50 per cent of certain population groups have been affected.

Isolates from these epidemics have been examined at the Walter Reed Army Institute of mediacl Research, the Public Health Service Communicable Disease Center Virus Laboratory at Montgomery, Alabama, and at other laboratories in the United States. Virus strains were found to be similar to each other but quite different from prototypes isolated from outbreaks in the past. Complement fixation tests demonstrated that the strains were type A influenza virus, but antibody in human and animal antisera prepared against other type A strains did not inhibit hemagglutination by the new variants. No antibody has been demonstrated in sera from people residing in the United States. These strains represent a new set of antigenic variants which could circulate readily through out the world. On the basis of these findings, the World Health Organization has alerted all influenza centers, and new strains have been distributed for further intensive studies.

Experience in the Far East indicates that influenza vaccines in current use do not protect against the new strain. Prototype virus has been submitted to several United States biologics companies, and they are manufacturing vaccine.

In view of the extent and rapidity of travel between the United States and the Far East, this newly recognized strain of influenza will probably be introduced into this country.

The Public Health Service has taken steps to study and to help control any local outbreak that may occur. Health departments of all the States have already been informed about the situation. The Division of Biologics Standards of the National Institutes of Health is working with the pharmaceutical industry in expediting the production of vaccine. The Virus and Rickettsia Section of the Communicable Disease Center Laboratory (which is the WHO Influenza Center for the Americas) is preparing diagnostic reagents for the recently isolated strains and distributing them to regional and collaborating laboratories throughout the country and the Western Hemisphere. Studies are being carried on at this laboratory of all recently isolated strains of influenza obtained through the WHO. The National Office of Vital Statistics is keeping public health authorities informed about developments. The Division of Foreign Quarantine is informing persons arriving from affected areas that should they become ill they should see their physicians without delay. The Epidemic Intelligence Service of the Communicable Disease Center, with officers assigned throughout the country, is ready to assist State and local health departments in the investigation of any occurrence of influenza.

The key to the situation, of course, is in the hands of the practicing physician. His alertness to any cases of influenza-type illness among his patients—or of this kind of illness in persons recently returned from the Far East, or their families or associates—

will provide the information needed to deal with the problem before it becomes widespread. It is urgent that such information be given promptly to local health authorities, to protect the community and the country from the possibility of a full-scale epidemic.

They will undoubtedly consider a diagnosis of influenza in any patient with symptoms of upper respiratory disease. The definitive diagnosis can be made only through virus isolations in the acute phase or by comparative titers of serum from the patient when he is acutely ill and when he is convalescent. Virus isolations require nose and throat washings obtained preferably during the first 3 days of illness and while the patient is still febrile, although virus may be recovered as long as 7 days after onset. The patient should gargle 3 times using about 15 ml. of diluent (broth, skimmed milk or distilled water) and returning the washing each time to the paper cup. Some infective material may be brought from the trachea into the pharynx if the patient will cough. The washings should be transferred to a closed tube for transportation to the laboratory and tested as soon as possible. If a delay of more than a few hours is necessary, the fluid should be kept chilled at refrigerator temperatures. When longer periods of storage are unavoidable, the washing should be frozen and stored, preferably near −70 degrees C. Serum samples should also be taken, one during the time of illness and a second 2 to 4 weeks later.

Not all laboratories are prepared to do virus isolation and serology for influenza. State health departments, however, can either do these procedures or refer the specimens to influenza reference laboratories such as the one at the Public Health Service Communicable Disease Center Virus and Rickettsia Laboratory, Montgomery, Alabama.

Although individual cases of influenza are not required to be reported by a physician, in order that the first signs of an outbreak can be detected, physicians should call health officers about suspected and proven cases of influenza occurring this fall.

Air Force Nutrition in Flight*

By

LT. COLONEL ALBERT A. TAYLOR, USAF (VC), AND HARRY C. DYME, PH.D.

(With six illustrations)

THE Aero Medical Laboratory at Wright Air Development Center works to improve the effectiveness of the human operator in relation to his aircraft and equipment, and minimize the combat hazards and environmental extremes to which he is exposed. The laboratory has specialists in many physical and biological sciences, in engineering, and in clothing fabrication.

The functions of the Laboratory which have to do with flight and survival foods and feeding are: determine the military and nutritional characteristics of special Air Force food packets and components such as, in-flight meals and survival food packets; transmit these characteristics to the Quartermaster Food and Container Institute for the Armed Forces for development of the items; test the special Air Force items after development for nutritional adequacy, field utility, and acceptability in the operational situation; formulate and test methods and procedures for making foods and beverages available in aircraft; develop, test, and standardize items of food servicing equipment such as hot cups, food warming ovens, galleys, and beverage containers for the preparation and storage of food and beverages aboard aircraft.

Basic information is secured and employed to establish nutritional requirements for flying. Food items are developed to meet these needs in coordination with the development of food service equipment to store, preserve, prepare, and serve food in flight. The foods and the equipment are tied together into smoothly functioning feeding systems. The feeding systems, as well as the components are field tested in flight and are finally installed and monitored to insure consistent high quality feeding.

In flight, such factors as barometric pressure and its sudden change, rapid temperature fluctuations, abnormal oxygen tension, turbulence, vibration, crowding, restrictive clothing and protective equipment, and cramped position affect the palatability of foods. Many things make men accident prone. These include tension, anxiety, irritation, fatigue, monotony, drowsiness, and discomfort. Aside from meeting a nutritional requirement, serving food and drink, through long established social custom relieves boredom, eases tension, soothes irritation, increases alertness, and counteracts stress. Thus, food not only meets a direct physiological need, it enhances morale and decreases the hazards of flying.

In addition to fuel value (calories), standards for flight feeding must consider:

1. *Quality.* In addition to the usual meaning of quality, this includes the type of food, acceptability, digestibility, and flatulence-producing properties. In other words, its functional utility in flight.

2. *Balance.* The proper proportion of proteins, fats and carbohydrates, and all of the various specific nutrients such as vitamins.

3. *Timing.* The interval between meals must not be prolonged. Light frequent feedings are better than heavy infrequent meals.

4. *Water.* Proper fluid intake to prevent dehydration is of great importance.

Not only must these distinctly different standards be determined, but valid information must be gathered to substantiate the abnormal feeding so often dictated by mission logistics. In essence, what must be determined is not only whether men will be malnourished when nutritional requirements are compromised, but more particularly the effect of such compromises on the efficiency,

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health, and safety of flying personnel. Nutritional status affects functional capability. Aloft, this direct response to feeding affects mission capability.

The level of nutrition presents no problem on short missions as there is little chance for what is generally termed nutritional deficiencies or caloric shortages to arise in well-nourished personnel. During such flights, the role of feeding in the stress-strain complex of flying is important. Pains and difficulties may and do arise. Operational conditions aggravate voluntary dehydration. Feeding must prevent or ameliorate these.

On extended missions the nutritional aspects of crew support are crucial. Modern aircraft require a high degree of mental efficiency at all times on the part of the crew members. Both mental and physical performance can be affected by the extent to which food intake meets nutritional requirements and the interval between meals. Long periods between meals result in nervousness, irritability, and tension. This can be alleviated by shortening the period between meals with a reduction in the size of meals. This also prevents the feeling of drowsiness, and disinclination for activity which follows the consumption of a large meal. In addition, large meals are physically inconvenient for people who are forced to remain in restricted positions and in certain postures. Proper flight nutrition should, therefore, be secured by providing adequate, appropriate food to meet the body's nutritional needs in light frequent feedings.

A water loss through sweating of even 2% of body weight may significantly lower efficiency. For high flight performance fluid intake must, therefore, aim to approach water loss. In hot environments, men tend to dehydrate between meals. Often they feel fatigued when their loss of energy is actually caused by dehydration. Most people drink the liquid they need at meal time, that is, their water balance is restored to normal or slightly higher when they eat. Flying personnel should, therefore, be fed frequently and at regular intervals. Since thirst is not a strong enough sensation to indicate the amount of water needed, the mere availability of water does not necessarily alleviate dehydration. Drinking must be encouraged. Highly palatable and acceptable fluids should be provided in a readily accessible and convenient form. Drinks should be kept cold; beverages and soups should be hot; and the variety of items should be fairly large. In situations where eating is difficult and at times impossible, techniques are being devised for the convenient consumption of adequate fluids by the use of a large variety of appetizing drinks and soups with appropriate equipment for storing, heating, and consuming them. The emotional value of food and eating assumes great importance under highly restricted flight conditions particularly on extended flights. Dietary dissatisfaction affects morale adversely. While recognizing the importance of taste and food preferences, we must not minimize the nutritional aspects.

Far too often tests and decisions are made on the basis of just tasting, and not of consuming the item in prescribed amounts at the same frequency and for the same length of time as the people who have to subsist on it. More precisely, items must be tested under actual flight conditions.

On the ground, there is little concern about the adequacy of the current Air Force diet. In the air, many limiting factors, such as weight, space, restricted movement, and oxygen mask, make normal feeding very difficult; and often permit only inadequate feeding. Emphasis of research and development is on making men most efficient rather than on preventing malnutrition. It is on the positive aspects of nutrition; the effect of nutrition on the Air Force mission.

Four standard types of flight meals are presently authorized for Air Force use:

Sandwich Meal. The Sandwich Meal, commonly called the box lunch, is one of the four types of meals authorized for in-flight feeding (Figure 1). The Sandwich Meal can be prepared from a large variety of foods. It has distinct value in the relief of flight strain and tedium, and is generally well liked if not too frequently repeated.

QM Food & Container Institute

FIG. 1. Components of the Sandwich Snack Meal.

The meals are prepared in a flight kitchen conveniently located in or near the flight operations building. The components are fairly reasonable in cost. Normally, the meal is eaten cold. In many instances hot coffee is served with the meal. An important feature is that this meal does not require any special equipment aboard the aircraft for processing or storage.

As in all operational feeding, it is necessary to understand not only the merits but also, the limitations of a feeding system. The Sandwich Meal is perishable. In order to avoid the possibility of food poisoning from bacteria or their toxins, the meal must be consumed within 5 hours after leaving the flight kitchen. This restriction limits its application to flights requiring one meal, or to the first meal on longer flights. Since the Sandwich Meal is not suitable for storage, it cannot be stockpiled. It is, therefore, not adapted to uses where large quantities must be available on short notice. However, considering this meal as a whole, its usefulness considerably outweighs its limitations. At present, it is the most commonly used of the in-flight meals.

An improved sandwich wrapper has been selected to prevent dehydration of the food at altitude. Wet waxed paper bags have been found economical and satisfactory. An easily assembled carton which saves labor and permits more rapid preparation of the meals has been standardized.

The time-temperature relationship of organisms that may cause food poisoning in the sandwich meal is under study. Based on this relationship, an indicator may be developed to show the wholesomeness of this lunch during flight. This should greatly increase the usefulness of this highly acceptable meal since frequently it can be safely used much beyond the present five hour limitation if storage conditions have been favorable.

Food Packet, Individual, In-Flight. The Food Packet, Individual, In-Flight, is the most versatile meal for in-flight feeding (Figure 2). Being a canned meal in a box, it lends itself to stock-piling for emergency conditions which is a factor of logistical importance. It does not require refrigerated storage or heating equipment aboard aircraft—a very important feature inasmuch as space and weight are critical considerations in the design of all modern aircraft.

This food packet is designed to be eaten cold; however, it is much more acceptable when the meat components are heated. For this purpose, special type heating equipment is included aboard some of the larger aircraft. Hot water is, of course, necessary to make coffee or tea from the instant products in the meal.

Each packet is a complete meal in itself. Ten different menus are available. The meal consists of 4 cans; meat, fruit, bread, and

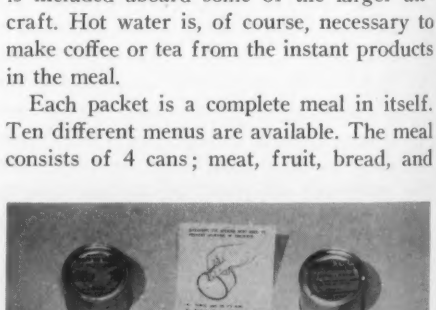

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FIG. 2. Components of Food Packet Individual. In-Flight IF-6.

dessert; and an accessory packet. The accessory packet provides instant tea, instant coffee, soluble cream, sugar, chewing gum, folding can opener; a plastic spoon, and paper towel and napkin. The meal averages 1200 calories and has proved to be very acceptable when consumed at irregular intervals. All components are packaged in a carton which may be used as a lap tray, and later as a receptacle to dispose of waste.

The in-flight canned food packet has recently been revised and improved. Menus are printed on the packet to allow a choice. Canned bread has replaced crackers. A highly acceptable canned pecan roll is included as a dessert item. Date of pack is shown on the can lids for purposes of rotation of stocks. Dry cream has replaced soluble milk. The lunch is in a white box.

An excellent canned chocolate nut roll has been developed as a dessert item. Some delay in its use had been encountered because it had not been absolved of the danger of botulinum toxin production on prolonged storage. It has now been established that C. botulinum cannot grow in this media. As a result canned chocolate nut roll is being included as one of the desserts.

An improved butter type of spread is being developed for use with the canned bread. Experimental formulae are being produced industrially and tested for storage stability. The non-toxic properties of the stabilizing glycerides will have to be demonstrated and established before the product is used.

Work has begun on a can that is more easily opened than the present one.

Precooked Frozen Meals. The precooked frozen meal was designed to provide a highly acceptable hot meal for the large, long-range aircraft in which several meals were needed on a flight (Figure 3). Use of this meal requires refrigerated storage and an oven for heating aboard aircraft. Hot cups or insulated liquid containers are also needed for hot coffee or tea.

The meals are in expendable aluminum containers. The only preparation required is placing the containers in the B-4 aircraft

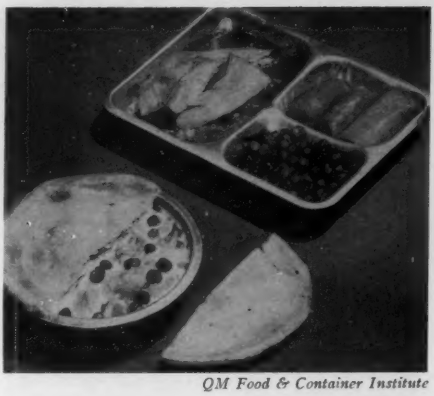

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FIG. 3. Casserole and Tray Types of Precooked Frozen Meals (Foil removed after heating).

oven. The meal requires about 30 minutes to reheat from 0°F. to 160°F. internal temperature. This meal needs to be supplemented with a beverage, a dessert, and bread and butter to be complete. To avoid monotony, 12 menus have been developed. As these meals are perishable, special precautions are taken to insure sanitation in the processing, and they are held in low temperature storage until reconstituted for consumption. Maintenance of low storage temperature is necessary to retain high acceptability of the product. The meals may be held for periods of six months or longer.

Research and development is increasing the number of components for use in precooked frozen meals, extending the shelf life, and enhancing quality. As more stable and highly acceptable foods are developed, they will be introduced into the menu plan. Although the precooked frozen meal has come a long way since its inception, the anticipated demands of the future place new emphasis on this mode of in-flight feeding.

Precooked frozen meals are being improved. New menus and items are under test and microbiological studies are in progress. A specification has recently been completed. Cured pork products are being stabilized so that they can be used in the precooked frozen meal. Bacteriological standards are being further defined for these meals. The thaw indicator for this meal is

FIG. 4. Foil Pack Meal Served on Multipurpose Lap Tray.

being improved to not only show if the food has been thawed, but also to detect poor storage temperatures which result in lowered acceptability.

The *Precooked Hot Meal,* authorized for use in the Air Force, is about the same as that used on commercial airlines. It is applicable only to those few bases where aircraft are on regular schedules and flights are of short duration. This fourth authorized in-flight meal is little used as it must be consumed shortly after take off.

The *Foil Pack Flight Feeding System* is a new method of flight feeding recently developed for large aircraft where weight, space, and power are fairly ample. Field tests at McClellan AF Base have shown this system to be highly satisfactory. The foods are prepared, seasoned, and packed into rectangular foil containers in the flight kitchen. The meals are taken aloft in a refrigerator (Figure 4). They are cooked during flight in a light weight Air Force oven and served from disposable lap trays. The foil containers also serve as dishes. This system provides freshly cooked, hot meals that are highly acceptable; and little or no preparation is required in the air. In the many attractive menus developed, the majority of foods are those issued to the dining halls. This feeding system is, therefore, quite economical.

Recent field tests at McClellan Air Force Base have completed the development of the Foil Pack Flight Feeding System. Nine thousand meals were used on RC-121 aircraft with excellent results. The system is being integrated into USAF flight feeding and is now in limited operational use at McClellan and Otis Air Force Bases. Provided operational use is continued and extended, further developmental effort will be initiated toward making this system available for flights of longer than three days. Freezing the food should allow the system to operate on these longer flights.

Eating aboard high performance aircraft is at the other end of the feeding spectrum from the Foil Pack Meal. Here facilities for feeding are highly critical and, at times, unavailable. As the original flight durations of some of these aircraft were short, feeding was initially deemed unnecessary; however, range extension techniques have changed the situation. The flyer, it is apparent, must be refueled as adequately and as consistently as his aircraft. Men must be fed where little or no space and weight allowances can be spared for food service equipment, storage of food, serving of food, and eating. In extreme cases, these restricted conditions are almost prohibitive. Food must be capable of consumption with the use of only one hand with no decrease in attention paid to flight duties. Food must not add to difficulty and discomfort that results from not being able to move out of the seat. Food must be highly acceptable so it can be eaten in flight without being heated, prepared, or served. Food must not spoil at ambient aircraft temperature for considerable periods. Setting up valid nutritional requirements to support mission capabilities within these "boxed" conditions, is a complex task. To accomplish this competently, the effect of feeding compromises on efficiency, health, and safety, must be determined.

The *Compact Box Lunch* is a new meal somewhat similar to the Sandwich Meal. It differs in that it has more accessible components and convenient bite-size sandwiches (Figure 5). Six menus have been developed;

three must be consumed within 5 hours of preparation and three may be safely consumed up to 20 hours after preparation without refrigerating. The Compact Box Lunch, following a preliminary test at McDill AFB was modified and improved. Additional tests at Barksdale and March AF Base have been completed, further improvements have been made, and this lunch is now ready for operational use on the B-47 and the B-52 aircraft.

Fighter pilots must be ready to go on a combat mission at the end of a long distance flight. Virtually all space in the cockpit which can be reached by the pilot is taken up by instruments and controls. The pilot is unable to get out of his seat. Moreover, he is heavily clothed and must wear oxygen equipment. He is kept very busy flying his aircraft. Added weight and power for feeding is not available. The food he takes along must be chosen prior to flight when he is not hungry. To meet these problems the Air Force must devise a feasible means of feeding these fighter pilots. Aircraft designs and the use of any given aircraft is constantly changing, thus we must keep up with field conditions, anticipate future conditions, and try to make Air Force feeding systems usable in many different situations. In addition, gas forming foods and high fiber foods must be avoided. The highest possible acceptability must be provided as food has to compete for the pilot's time and attention.

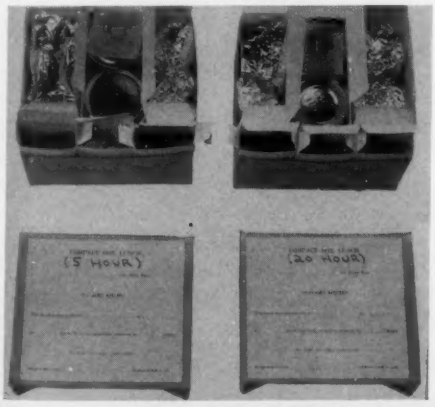

FIG. 5. Compact Box Lunches.

FIG. 6. Some Commercially Available Liquid Foods and a Can Piercing-Drinking Device.

A large variety of liquid foods have been developed for high altitude feeding (Figure 6). An improved chocolate milk and a lemonade, have been approved and specifications written. Several others, caramel, vanilla, raspberry and coffee flavored milk drinks are now available. These are being field tested. Flavored milk drinks are highly successful. Development of meat-type drinks is, as yet, not successful. A canned liquid chicken and a liquid ham are being developed and these show considerable promise. Fruits and vegetable juices are already widely available.

Prototypes of a variety of food tablets for high altitude and restricted flight situations are being produced. Chocolate butter cream, cheese, maple, butterscotch, orange, grape and others are available. Some of these have been field tested in conjunction with a dispensing device being developed for them.

Work has been initiated to develop semi-solid foods in tubes for use at high altitude. These foods will be packed in flexible metal or plastic dispensing containers with elongated spouts. The food can be eaten by passing the spout through an aperture in the helmet facepiece or it can be eaten directly from the tube. Good caloric density can be achieved. A series of such foods which can be used in conjunction with and as complements to liquid foods and food tablets for highly restricted feeding situations, will increase variety and thus improve acceptability.

Feeding neglect, deviations, nutritional compromise, and physiological abuse cause

no undue hardship for periods of eight hours but become stressful in 24 hours, and may impair weapon system effectiveness in 48 hours. Whether the reaction to these is physiological, psychological, or both, the end result is detrimental to the Air Force mission. The new aircraft being developed make further demands on these feeding systems. Greater versatility in the use of present aircraft is constantly increasing demands on the Air Force feeding systems.

While feeding has all too often been placed in the unfortunate position of retrofitting into an already jelled flight situation, this need not continue. Present research and development is cognizant of, and plans for the future. Atomic flight will someday be a reality. Obviously the effect of radiation on the food has to be taken into account. If anything, space and weight limitations will become more critical, and monotony will be a paramount problem. The psychological challenges of a long stay aloft are much like those posed by underwater operations. A premium type of feeding will have to be accomplished within a stringently limited space, weight, and work relationship. This challenge confronts the Air Force now.

It is taken as a matter of course that cut fingers, bruised arms, and stomach aches be given immediate attention. Emotional First Aid is just as important as First Aid for physical illness.—Dr. Wm. Menninger, "Mental Health for Executives"—Address to American Association of Advertising Agencies.

Medical Operations in Radiologically Contaminated Areas*

By

LIEUTENANT COLONEL JAMES B. HARTGERING, MC, U. S. ARMY†

(With two illustrations)

IN THE past few years nuclear weapons have become integrated into the family of weapons directly available to the battlefield commander. Their potential impact on combat has led to broad new concepts involving reorganization of all phases of military operations. Most of the contemplated changes have been designed to minimize the immediate casualty producing effects: blast, thermal and initial radiation, and have centered around increased dispersion and mobility of units. The purely medical aspects of mass casualties are beginning to be appreciated, and realistic planning is developing which recognizes the probability of a serious disparity between the number of injured requiring care and available medical facilities.

During the early research program of the Manhattan Engineer District, it was recognized that tremendous amounts of nuclear radiation, millions of curies of radioactivity, would be released by the fissioning of uranium or plutonium. Elaborate personnel safety precautions were taken at Alamogordo during the first test. Only minor ground contamination was observed beyond the immediate test area, as the device was detonated some distance above the ground. Two years later at Bikini, the local radiation effects of an underwater kiloton burst were outlined in some detail. Significant radioactivity was limited to a relatively few square miles, and it was apparent that except for unusual circumstances, such an area could be isolated and avoided. The possibilities of widespread ground contamination were publicized following the Pacific Tests of 1954, when the Atomic Energy Commission announced that more than seven thousand square miles could be covered by the fallout of a single surface burst thermonuclear weapon.

If multiple weapons of various yields are employed in a military theater of operations, fallout contamination can be expected. The tactical mission may require the movement of troops through these areas in the forward combat sector or in the logistic zone. The doctrine for military operations is still being studied, but several medical questions related to radiation exposure will arise irrespective of the final decisions. What will be the immediate effect on the individual soldier and his ability to fight? How will limited exposures alter the health of the command? What preventive measures are possible? How will large fallout areas influence medical plans and operations? Finally, what evacuation policies and estimates of hospital requirements should be adopted for radiation injuries? The answers to these questions are not readily apparent because much of the fundamental research has not been completed; nevertheless, it would appear reasonable to pose the problems and consider them in the light of today's knowledge.

As a basis for the discussion of the principles involved in seeking answers to these questions, let us review some of the physical factors relating to the formation of large area radiological contamination or fallout. The fissioning of a mass of uranium or plutonium results in the production of countless numbers of micron size radioactive particles

* Presented at the 63rd Annual Convention of the Association of Military Surgeons of the United States, Washington, D.C., November 12-14, 1956.

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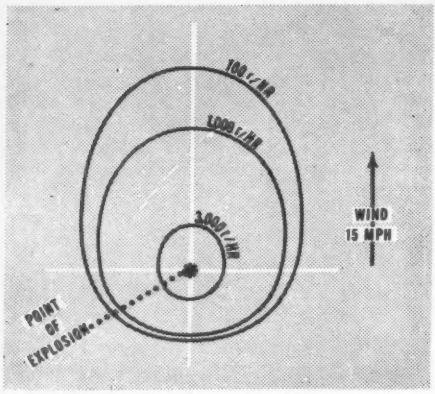

FIG. 1. Fallout pattern. From "Radiological Recovery of Fixed Military Installations," U. S. Naval Radiological Defense Laboratory, San Francisco 24, California.

called fission fragments. These are mixed, in a surface detonation, with the tons of pulverized dirt excavated by blast effects of the weapon. The mixture of fission fragments and dirt rises into the air and is dispersed depending on prevailing meteorological conditions. In general, as noted schematically in Figure 1, the fallout pattern occurs downwind from ground zero. The size and shape of the contaminated area depend largely on the yield of the nuclear explosion and the direction and velocity of the wind at various altitudes. Although an idealized cigar-shaped fallout pattern has often been used to represent the fallout area, ground deposition of dirt and fission materials will actually be irregular and may take almost any imaginable form. Radioactive fission fragments consist of some two hundred different isotopes, each decaying at its own fixed rate with the emission of gamma rays and/or beta particles. Repeated measurements at the time of nuclear tests have shown that the combined decay rate of all the isotopes follows a fairly regular scheme which is expressed by the familiar $t^{-1.2}$ law. Utilizing standard graphs and tables to make the necessary time corrections, isointensity lines, in roentgens per hour, can be drawn through the fallout pattern connecting points of similar activity. These lines are also drawn symmetrically for planning or illustration purposes when fallout patterns are shown on large scale maps. In practice, however, local terrain irregularities such as small hills and depressions will result in variations of measured radioactivity by as much as one hundred per cent. Even greater variations in dose rate will be associated with larger terrain features. This non-uniformity could be of great practical importance to troops on the ground provided detailed radiological surveys are possible. Finally, it should be remembered that fission product gamma radiation has a range in air of a few hundred feet. Thus, an individual standing in the open receives his exposure from a circular area of such a size that the measured dose rate does not change abruptly as he moves about on foot. Earth, however, offers excellent protection, and even relatively shallow depressions or foxholes will markedly reduce the dose an individual would otherwise receive. Deep, covered, field fortifications provide virtually one hundred per cent protection.

With this brief review in mind, let us consider the general situation of a military force committed to combat in an area where nuclear weapons have been and may continue to be employed. For discussion purposes, staff medical responsibilities can be divided into two phases: (1) Recommendations as to the probable effect of radiation on military units, and (2) Operational plans for the hospitalization and evacuation of patients.

If we assume that limiting features of terrain and enemy action require maneuver through a moderately contaminated area, the commander is then committed to the planned exposure of his troops to nuclear radiation. Inherent in conventional combat, is the risk of possible injury or death. Based on his estimate of enemy strength, fire power, a knowledge of the terrain, and many other factors, the commander assesses the risks involved and plans his movements so as to accomplish the mission with a minimum number of casualties. The surgeon is consulted concerning applicable medical recom-

mendations. Identical principles apply when a radiation field is to be encountered, but requirements for the surgeon's recommendations may be increased. The interpretations of the effects of mild or moderate radiation intensities are complex. Medical judgment would appear to be essential as there is insufficient fundamental information to prepare numerical tables or graphs of sufficient accuracy for general use. Medical authorities have published estimates of the response of man to various doses of radiation, but these predictions were derived primarily to provide a general basis for planning requirements. Generally accepted predictions are as follows:

50r—No casualties. No reduction in combat effectiveness.

100r—2 per cent may have nausea and vomiting for a short period of time. No evacuation contemplated. No significant reduction in combat effectiveness.

200r—25 per cent nausea and vomiting in a few hours. No significant reduction in combat effectiveness. No evacuation.

250r—SD/50. All must be evaluated by unit surgeon as soon as possible. 30 per cent may require evacuation.

300r—Approximately 10 per cent deaths. All may need evacuation as soon as tactics will permit.

500r—50 per cent deaths.

Over 650r—Lethal dose, but not necessarily for all so exposed.

The accuracy of this data, in the casualty producing range, is probably not more than plus or minus fifty per cent. The estimates relate to single doses and assume no significant previous exposure. The effects of chronic exposure are even less well understood, and except for amounts below twenty-five roentgens, no actual human data exists.

The basis of our current estimates is the extensive accumulation of experimental field and laboratory animal data as modified by a limited number of recorded responses in man. Our knowledge of the details of human radio-biology is, therefore, limited, but certain broad principles have been developed which may be summarized as follows:

(1) All radiation is potentially harmful.

(2) Exposure dose rate is critical. For the same dose, say two hundred roentgens, the acute effects are greater if the energy is absorbed in less than one day than if prolonged over a week or more.

(3) Recovery occurs with time. As with other non-lethal wounds, healing or recovery follows the injury, but a certain fraction of the damage is irreparable and a "scar" remains.

(4) Late effects may occur after months or years; these may include carcinogenesis, anemia, genetic effects and, although not demonstrated in man, a shortening of life expectancy.

Decisions relating to the interpretation of these principles in a tactical operation will require the utmost in the art of military medicine.

Perhaps the surgeon's first problem is to evaluate the previous radiation history, if any, of the military unit. When was their last exposure and how much did they receive? It is probable that the answer will not be simple. Some of the new replacements may have received no previous radiation; whereas others may have had varying amounts over differing time intervals. Practical methods of recording exposure levels have not been established, although interim dosimeters have been adopted by the military services. In addition to inherent inaccuracies in dosimeter readings, normal biological variations to the same dose will limit the usefulness of a dosimeter reading when applied to single or small groups of individuals. Further, it will be an extremely difficult administrative problem to keep an accurate and meaningful account of previous exposures. Since a certain fraction of all radiation injury is irreparable, records should contain all possible exposures, including those prior to military service. Some authorities contend that physical dosimeters will never be satisfactory for military use except in special risk situations, and that the only practical solution is a medical appraisal of the individual's "radiological health." No clear-cut criteria are available today which will permit a medical evaluation of other than fairly

substantial amounts of radiation. This is particularly true if we consider chronic radiation exposure below the symptomatic threshold. Such criteria are required before we can objectively measure the over-all health of a military command.

In view of the biological variables in a prediction of the radiation effects on troops, it appears essential for the surgeon to evaluate the over-all tactical situation. There are at least three factors to be considered. The first relates to the reliability of the data on the level of activity in the radiation area. Its outline may have been obtained in detail from a previous survey by armored vehicles, or it may have been only generally mapped by air reconnaissance. Next is the training and experience of the men. Do they appreciate the value of protective terrain shielding so as to minimize exposure? Are their radiac instruments adequate and operating properly? Finally, what is the nature of the operation and the probable time lapse? If close combat is planned, the probability of enemy action and delays must be evaluated. In rear areas, alternate routes and maximum use of vehicles are of primary consideration. Actual dose calculations, which include these and other variables, will be prepared by other members of the Army staff. After obtaining all available information, the surgeon is then able to make appropriate medical predictions and recommendations. The commander will require a specific opinion of the effect of radiation on the individual soldier's fighting ability as well as the future military capability of the unit. Following a cumulative exposure of approximately two hundred roentgens, a detailed physical analysis of the command is recommended in order to define the nature of subjective complaints, if any, and evaluate the status of those individuals without symptoms. This does not imply medical evacuation, but rather is the responsibility of the unit surgeon. Personnel will not be evacuated unless illness develops which, in the judgment of the surgeon, cannot be treated locally. In addition to individual symptomatology, the general health of the command may be influenced by radiation exposure. For example, an increased susceptibility to infections has been a consistent finding in laboratory animals. Antibiotic sensitive organisms, however, respond well to the usual therapeutic dosages.

The Army surgeon responsible for hospitalization and methods and routes of evacuation has always given primary consideration to the welfare and safety of patients. The possibility of radiological fallout on field hospitals or the contamination of surface routes of evacuation requires additional precautions. Animal data on the effects of radiation combined with traumatic injuries and burns are somewhat contradictory. There has been only an occasional experiment designed to evaluate medical treatment in terms of survival, but all radio-biologists agree that the combination of sub-lethal radiation and other wounds will increase the morbidity and perhaps eventual mortality. When possible, medical installations should be located, not only far enough from likely military targets to avoid the blast and thermal effects of nuclear weapons, but also in an area not directly downwind from a target complex. Although wind direction cannot be predicted for any specific hour or day, the prevailing wind direction will be available from long range forecasts prepared by meteorologists.

Following selection of a hospital site, the surgeon is then responsible for passive defense plans which will minimize possible nuclear weapon effects. Plans for the emergency movement of patients and hospital staff should be prepared. Obviously, the best preventive measure is to evacuate potentially contaminated areas, but practical operational limitations and the medical requirements of recent postoperative and critically ill patients will often limit rapid movement. Emergency plans will require coordination with other staff officers to insure sufficient transportation and the designation of a suitable prepared reception area. Evacuation not purposefully directed is likely to result in

an even larger number of casualties. Passive defense measures will normally provide adequate radiation protection for medical installations. Coordination with the Army Engineers is required to obtain the heavy equipment needed to "dig in" and construct shelters for patients and hospital staff. If it is not possible to develop underground areas, sandbag or other surface protection can provide reasonable protection. Plans for decontamination of patients, hospital personnel, and the hospital area are required. All personnel can be brushed or washed as required without difficulty. Hospital personnel can remove the radioactive "dirt" from small areas such as roofs and floors using brooms and shovels, but technical teams and earth moving equipment are needed to effectively decontaminate the hospital area. It will usually be best to wait for radioactive decay before attempting physical methods, but if the initial intensity is high, some eventual decontamination will be required if the area is to be continuously occupied. Complete removal of the radioactivity is probably not practical, but a significant reduction in radiation intensity can be achieved by covering or removing the surface layer of earth in the immediate hospital area. If a strip one hundred and ten feet wide can be cleared, the radiation will be reduced by ninety per cent as illustrated in Figure 2. Although this would require a major effort, the result could be lifesaving if the patients were non-transportable.

Similar plans will be necessary for normal patient evacuation. Air transportation, of course, avoids the problem of ground contamination, but if aircraft are not available, ambulance routes should be selected to minimize radiation exposure. Detailed dosage calculations will be required to minimize exposure of patients and ambulance crews. When available, the use of armored vehicles will provide more than twice the protection of conventional ambulances.

Planning for the care of military personnel in a theater of operations must include estimates of the number and type of battle

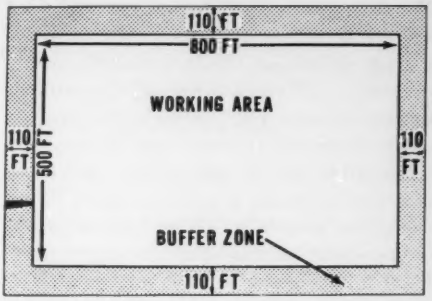

FIG. 2. Hospital area. From "Radiological Recovery of Fixed Military Installations," U. S. Naval Radiological Defense Laboratory, San Francisco 24, California.

casualties, as well as non-battle losses. Evacuation policies and estimates of hospital bed requirements can be made only after considering both the tactical situation and the probable types of injuries. Experience factors exist for conventional and non-battle casualties which will permit realistic estimates of the probable return to duty time and the requirements for long term hospitalization. There are no experience factors for radiation sickness, but the following figures may be derived from experimental data. Individuals absorbing two hundred to three hundred roentgens, who develop subjective symptoms and have a significant decrease in leucocytes, will require thirty to sixty days hospitalization. Individuals exposed to less than two hundred roentgens will not require evacuation, and those exposed to over three hundred roentgens will require more than sixty days hospitalization. Radiation combined with other injuries will increase the time of hospitalization. It is estimated that the combination of two hundred roentgens, and other injuries which require admission, may increase the time of hospitalization by thirty to fifty per cent. The actual dose in each case is only of relative importance due to individual variations, but an order of magnitude is required for planning purposes.

The possible implications of late radiation effects perhaps require specific comment.

The late effects have been well publicized and are becoming of general concern to the average individual. While it is doubtful that the soldier will concern himself about tumor formation some years later, many have already expressed concern over sterility and the possible genetic implications. We know that sterility is not a problem, but it is unlikely that knowledge of the genetic effects in man will be available for many years. Faced with concern of these problems today, or in the near future, the military surgeon will be required to discuss the subjects simply and positively in such a way as to allay psychological concern. In addition, recommendations to the commander should include an evaluation of the long range implications. In all probability they will rarely influence direct military operations, but if we are to fulfill our responsibilities as physicians we must consider long range as well as immediate effects.

This brief presentation has attempted to bring to your attention some of the implications of the radiological aspects of nuclear weapons. These effects will require adjustments in medical planning and may result in greater responsibilities for the staff surgeon in providing tactical recommendations to the commander. Our current understanding of the various parameters relating to the effects of radiation on man is limited, but sufficient information is available for general planning purposes.

Government can be bigger than any of the players on the field as a referee, but it has no right to become one of the players.

AUSTIN IGLEHEART, *Forbes*

Clotting Factor Abnormalities in Chronic Liver Disease*

By

SAMUEL I. RAPAPORT, M.D.,† AND JOSEPH R. GOODMAN, PH.D.‡

(With one illustration)

THESE studies were supported by grant #2453 from the National Heart Institute, National Institutes of Health, United States Public Health Services, Bethesda, Maryland.

Although abnormal bleeding in chronic liver disease is common, its causes are poorly understood. At times, bleeding is associated with multiple hemostatic defects that involve not only the plasma clotting factors but the thrombocytes and the blood vessels. The problem is to decide which defects are really to blame for the bleeding.

Conversely, patients may bleed abnormally with little or no disturbance in the usual clinical laboratory clotting tests. The authors have seen profuse hemorrhage at surgery or after dental extraction in cirrhotics with no clotting abnormality except a slight prolongation of the Quick "prothrombin time." Such bleeding is controlled at times by fresh but not by bank blood. Since bank blood supplies prothrombin, this bleeding must stem from another cause.

Such experiences suggest that uncontrollable bleeding from esophageal varices may be partly due to an unrecognized hemostatic defect. Linton and Ellis's statistics[1] support this possibility. They reported no deaths from exsanguination in 28 patients with gastro-intestinal bleeding due to extra-hepatic portal bed block. In sharp contrast, 23 of 65 bleeding patients with intra-hepatic block secondary to cirrhosis died of exsanguination. These considerations prompted us to re-examine plasma clotting factor activities in chronic liver disease. In this paper, we shall present two sets of data from patients with portal cirrhosis. The first set relates the Quick "prothrombin time" to tests that specifically measure prothrombin and its accessory factors, proconvertin (Factor VII, SPCA, stable factor) and proaccelerin (Factor V, plasma Ac-globulin, labile factor). The second set is measurements of PTC activity (plasma thromboplastin component, Christmas factor, anti-hemophilic B factor).

It is well known that the Quick "prothrombin time" is often abnormal in both obstructive and parenchymal liver disease, and that it returns to normal after Vitamin K in the former but not in the latter. Less well known is the fact that the Quick test measures not only prothrombin, but also proconvertin and proaccelerin activity. A prolonged Quick time may mean reduction in any or all of these clotting factors. Moreover, one group[2] believes that the Quick test will fail to disclose a major depression of prothrombin when proconvertin activity is not depressed as well. These workers reported two examples of bleeding in liver disease in which a severe prothrombin deficit, demonstrated by a two-stage method, resulted in only moderate lengthening of the Quick "prothrombin time." Therefore, it seemed important in a series of patients to compare Quick test values with those obtained by a test that specifically measures prothrombin alone.[3]

Proaccelerin levels fall in chronic parenchymal liver disease.[4,5,6] However, the pub-

* Presented at the 63rd Annual Convention of the Association of Military Surgeons of the United States held in Washington, D.C., November 12-14, 1956.

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lished quantitative data are insufficient to evaluate the extent or frequency with which this occurs in the usual run of cirrhotic patients. Sensitive tests for proaccelerin are not available in most hospitals, many of which still rely solely on Quick's test. More data on proaccelerin levels in cirrhosis seemed necessary, particularly to determine if proaccelerin levels are predictable from the Quick test alone.

Although anti-hemophilic globulin (AHG) levels remain normal in liver damage,[7,8] the fate of plasma thromboplastin component (PTC) is less certain. Since PTC, prothrombin and proconvertin share many physico-chemical properties, possibly including dependence upon Vitamin K for synthesis, suspicion arose that PTC levels might fall along with prothrombin and proconvertin in cirrhosis. Therefore, the PTC activity of serum samples from a group of cirrhotic patients were measured using a modified thromboplastin generation technique to be described below.

Methods

The Quick "prothrombin time" test was done as usual except that human brain thromboplastin prepared by Owren's technique[9] was used in place of rabbit brain thromboplastin.

The combined effect of prothrombin and proconvertin was measured by the P. and P. test of Owren and Aas.[10] The only modification was adsorption of the ox plasma both by barium sulfate and Seitz filtration.

Prothrombin was measured by the specific one-stage prothrombin assay with venom-cephalin of Hjort, Rapaport and Owren[3] used exactly as described.

Proaccelerin was measured in a one-stage assay using an artificially prepared proaccelerin deficient substrate plasma made by incubating normal oxalated plasma under oxygen at pH 8.2 for about 24 hours.

The clotting mixture consisted of:

0.2 ml of substrate plasma (supplies excess of prothrombin, proconvertin and fibrinogen)
0.2 ml of human brain thromboplastin
0.2 ml of a 1/20 dilution of the test plasma (the only source of proaccelerin for the system)
0.2 ml of calcium chloride (optimal strength between 30 and 45 mM depending upon the oxalate conc. of the substrate plasma).

Normal plasma gave a clotting time of about 35 seconds in this system and control buffer about 100 seconds. Thus, this assay was sensitive enough to detect small differences in proaccelerin activity.

PTC activity was measured by the ability of a test serum to correct defective thromboplastin formation in a PTC deficient incubation mixture. The technique was a modification of the thromboplastin generation test. The incubation mixture consisted of:

1. "Cephalin" prepared as described elsewhere and diluted 1/50 in veronal buffer.[11] This provided the equivalent of platelet thromboplastic activity.

2. Adsorbed normal plasma, prepared by adding 0.1 ml of aluminum hydroxide to each ml. of citrated plasma and incubating at 37°C. for 3 minutes. The adsorbed plasma was diluted 1/5 in buffer before use. This reagent supplied AHG and proaccelerin to the incubation mixture.

3. A PTC deficient reagent made from Hemophilia B serum and designed to provide anything in serum besides PTC that might be needed for thromboplastin formation. Serum was separated from Hemophilia B blood 4 hours after clotting and 0.1 M sodium oxalate was added in the ratio of 1 part of oxalate to 5 parts of serum. After standing overnight at 4°C., the serum was acidified, re-neutralized and adsorbed with barium sulfate exactly as described by White and his associates.[12] A prothrombin free, "PTC deficient PTC reagent" resulted. This was diluted 1/10 with buffer before use.

4. Test serum, prepared by allowing blood to stand for 1 hours after clotting, separating the serum, adding 0.1 M sodium oxalate in a 1/5 ratio and allowing the oxalated serum to stand for 2 hours at room tempera-

ture before use. Some samples were stored in the liquid frozen state at −20°C. for several days to several weeks before testing. This test serum diluted 1/20 with buffer before use was the only PTC source for the incubation mixture.

5. 30 mμ calcium chloride. The incubation mixture consisted of 0.4 ml amounts of each of the above reagents. At 3 minute intervals for 15 minutes after adding the calcium, 0.2 ml of the incubation mixture and 0.2 ml of 20 mμ calcium chloride were added to 0.2 ml of normal oxalated substrate plasma and the clotting time measured. All tests were at 37°C.

A correlation curve was prepared daily using dilutions of normal serum ranging between 1/20 and 1/300. This permitted expression of the clotting times as per cent of normal PTC activity. We found, as had others,[13] that maximum thromboplastin formation in such an incubation mixture was often delayed when liver disease serum was used. Therefore, only the value after 15 minutes of incubation was used for the correlation curve and for determining the per cent of PTC activity of the test serum.

Results

The Relation Between the Quick "Prothrombin Time" and Specific Assays of Prothrombin and Its Accessory Factors

The Quick, prothrombin-proconvertin (P. and P.), specific venomcephalin prothrombin, and one-stage proaccelerin tests were done on plasma from 18 patients with portal cirrhosis. The results are listed in Table I, in descending order of the Quick test values.

The first patient is a "compensated" cirrhotic tested after months of bed rest in preparation for portal shunt surgery. The second has hemochromatosis with an enlarged liver and abnormal liver function tests but without ascites or jaundice. The remaining patients were cirrhotics hospitalized with ascites, jaundice or both.

As Table I shows, a good correlation was found between the Quick and P. and P. tests.

Table I

Prothrombin and its Accessory Factors in Portal Cirrhosis

(All values in per cent of normal)

Patient	Quick Test	P.-P. Test	Ven.-Ceph Proth. Test	Proacc. Test
1.	100	92	71	65
2.	85	70	50	81
3.	75	80	100	70
4.	72	90	80	63
5.	68	60	49	60
6.	68	55	60	55
7.	68	70	40	70
8.	65	54	33	37
9.	62	84	42	50
10.	60	70	36	39
11.	50	57	40	45
12.	43	46	27	20
13.	42	54	74	33
14.	40	47	31	25
15.	40	52	36	23
16.	35	46	28	25
17.	33	40	28	28
18.	29	25	17	13

Mild depression of one was accompanied by mild depression of the other. However, Quick test values below 65 percent were usually lower than the corresponding P. and P. values. This may be because the P. and P. test is independent of the proaccelerin content of the test plasma.

There was also a correlation between Quick test values and those obtained for prothrombin by the specific venom-cephalin method. However, with the exception of cases 3, 4, and 13, true prothrombin values were lower than either the Quick or the P. and P. test indicated. This is the converse of what happens during anti-coagulant therapy where long Quick and P. and P. times may result from proconvertin depression without marked prothrombin depression.

No patient was found with a severe prothrombin deficit and only moderate prolongations of the Quick time as described by Donald and coworkers.[2] In our series, the more normal Quick test and specific prothrombin values were within 20 to 30 percent of each other. At lower Quick test levels, prothrombin values were about 5 to 10 percent below the Quick values and 10

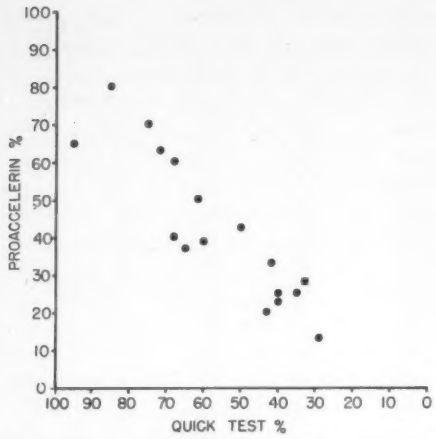

FIG. 1. The relation between the Quick Test and Proaccelerin levels in portal cirrhosis.

to 20 percent below the P. and P. values.

We were particularly interested in proaccelerin in cirrhosis, for this accelerator plays a key role in the rapid conversion of prothrombin to thrombin. As Table I and Figure 1 both illustrate, proaccelerin levels were subnormal in every patient. When the Quick test was 60 percent or lower significant proaccelerin depression was the rule. This was so consistent that we now believe that every cirrhotic with an abnormal Quick test has a reduced plasma proaccelerin level.

It must be emphasized that this relation holds only for chronic parenchymal liver disease. Owren[4] and others[5] have shown that normal or even elevated proaccelerin levels may be found in acute hepatitis and in obstructive jaundice. Thus, measurement of proaccelerin may help to distinguish chronic parenchymal from other forms of liver disease.

The degree of proaccelerin deficit in some of these patients suggests that this can not be ignored as a possible cause for abnormal bleeding. For example, if a patient with an initial praccelerin content of 25 percent of normal starts to bleed from esophageal varices, it is conceivable that the increased use of proaccelerin plus the decreased liver function resulting from the hemorrhage might lead to a further fall in proaccelerin to levels insufficient for adequate hemostasis.

PTC Activity in Cirrhosis

Serum samples from 15 patients with "decompensated" cirrhosis were analyzed for PTC activity using the above described thromboplastin generation technique. The 15 minute incubation value expressed in percent of normal, is given in Table II. It is important to allow a full 15 minutes incubation time, for as Duckert and co-workers have pointed out,[13] maximum thromboplastin formation may be delayed with liver disease serum. However, as Table II indicates, the thromboplastin finally formed is just as potent as that obtained with normal serum. No decrease in PTC activity in cirrhosis could be demonstrated. Apparently, neither AHG nor PTC deficiency can be incriminated in the abnormal bleeding tendency of cirrhosis.

TABLE II

PTC ACTIVITY IN PORTAL CIRRHOSIS

Patient No	PTC Activity (% of normal)
1.	100
2.	90
3.	100
4.	85
5.	90
6.	100
7.	85
8.	100
9.	100
10.	100
11.	100
12.	100
13.	85
14.	85
15.	80

Summary

The Quick "prothrombin time," the prothrombin-proconvertin test of Owren and Aas (P. and P. test), the specific venom-cephalin prothrombin test, and a one-stage proaccelerin test were performed on plasma samples from 18 patients with portal cirrhosis.

As expected, a correlation was found between the Quick and the P. and P. tests. However, Quick test values below 65 per-

sent of normal were usually a little lower than the corresponding P. and P. values.

Specific prothrombin levels were usually lower than either the Quick or the P. and P. test indicated. True reduction in prothrombin is consistently found in cirrhosis.

Proaccelerin levels were depressed in every patient. Thus, if the Quick test is prolonged in cirrhosis one may infer the existence of a proaccelerin deficiency. Proaccelerin levels below 30 percent of normal were not uncommon. Such proaccelerin deficits may help explain the abnormal bleeding tendency of cirrhosis.

PTC activity was analyzed in serum samples from 15 patients with "decompensated" cirrhosis using a modified thromboplastin generation technique. No decrease in PTC activity could be demonstrated.

ACKNOWLEDGEMENT

We wish to thank Mrs. Maria Friedland for her technical help in this study.

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A Rapid Method for Oxygenation of Stored Blood*

By

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(With two illustrations)

THE use of oxygenated blood for aortic infusion during open cardiac surgery, and certain of its favorable storage characteristics compared to venous blood, have created a need for a method of oxygenating banked blood. The purpose of this paper is to describe a simple, rapid and safe method for the in vitro oxygenation of banked blood by utilizing solutions of hydrogen peroxide, the enzyme catalase and an antifoaming agent.

A more durable method for preserving whole blood currently represents one of the greatest investigative challenges in the proper planning for the management of mass casualties. The electrolyte and pH alterations inherent in the use of A-C-D solutions, combined with the marked degree of continued hemolysis noted with this solution, leaves this blood preservative far from ideal.[1]

Many other anticoagulants and blood preservatives are currently being investigated in this regard, including ion exchange resins,[2] storage at extremely low temperatures,[3] and the use of various nucleosides.[4] More recently the storage advantages of oxygenated blood have been described[5] and suggest its further investigation.

Concomitant with this need for a supply of oxygenated blood has been its use in certain open cardiac operations where oxygenated blood is infused into the aorta during periods of inflow cardiac occlusion. According to this technique[6] oxygenated blood is pumped into the aortic arch under arterial pressure during the period of open cardiotomy, perfuses the base of the aorta, is stopped by the intact aortic valve, and thus enters the coronary vessels and oxygenates the myocardium. As usually employed, only the heart and brain are so infused, thus limiting the perfusion requirements. Oxygenated blood has been obtained by warming the forearm of the donor in hot packs for 20-30 minutes prior to venesection,[7] thus opening such a myriad of arterio-venous communications that blood withdrawn from the antecubital vein has an oxygen content approaching that of arterial blood.[8]

Gaseous and oxygenated blood has also recently been used for arterial infusion in peripheral arterial disease in order to increase tissue oxygenation.[9]

These various uses for oxygenated blood make a simple, safe and quick method for its collection of practical importance.

Methods

In order to minimize foaming, Dow-Corning Anti-foam‡ A is sprayed into the donor bottle before the collection of the blood. This material has been used extensively as a defoaming agent in various modifications of pump oxygenators and has proven to be non-hemolytic and non-toxic.[10] Less than 1 ml of this antifoam agent is required in a 500 ml bottle. The liquid vehicle promptly evaporates, leaving a thin layer of the oily silicon film on the inside of the bottle.

An alternate method, when the donor bottle is already filled with venous blood, is to spray 0.2-0.5 ml of the antifoam agent into the filled blood bottle via a 5 ml syringe and a 15 gauge needle. Two such needles are inserted through the rubber stopper of the bottle, one as an outlet, the other for injecting the antifoam agent. It is immaterial whether the antifoam agent so injected ad-

* Presented at the 63rd Annual Convention of the Association of Military Surgeons of the United States, held in Washington, D.C., November 12-14, 1956.

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‡ Obtained from Dow Corning Co., Midland, Michigan.

heres to the side of the bottle or spreads on the top of the blood.

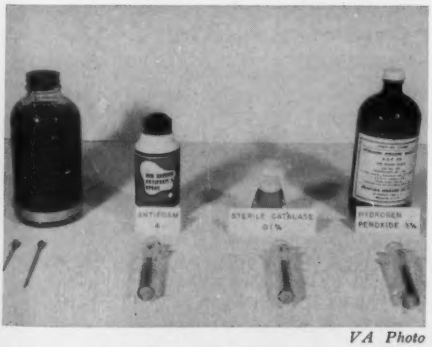
One of the #15 gauge needles is then withdrawn from the stopper and reintroduced into the glass tube air vent that runs to the bottom of the bottle. Material introduced through this needle, with the bottle in the upright position, obviously first contacts the blood at the bottom of the bottle.

A 0.1% stock solution of beef liver catalase in a phosphate buffer is freshly prepared each day, sterilized by passage through a Seitz filter, and kept in a 4°C. cold room when not in use. This material is relatively stable, being one of the more resistant of known enzyme solutions (Figure 1).

Five ml of this solution is injected into 500 ml of blood via the tube reaching the bottom of the bottle, and is slowly mixed by a few rotations of the bottle (Figure 2).

A stock solution of 3% hydrogen peroxide solution in saline is prepared by properly diluting a commercially available 30% hydrogen peroxide solution. This solution should be stored in a refrigerator in an amber bottle, since it slowly degenerates, releasing oxygen. Sterility of the solution is attained automatically by the hydrogen peroxide.

Five ml of the 3% peroxide solution is slowly injected into the blood filled bottle over a period of 5-10 seconds via the glass tube reaching the bottom of the bottle. As the hydrogen peroxide solution mixes with



VA Photo

FIG. 1. Materials required for oxygenation of banked blood.

VA Photo

FIG. 2. Addition of catalase solution into the tube leading to the bottom of the bottle. After injection thorough mixing is obtained by gently rotating the bottle.

the blood-catalase mixture, tiny oxygen bubbles appear in great numbers and the dark venous blood assumes the bright red color of oxygenated blood. Foam is formed at the bottom of the bottle but as the gas rises it contacts the antifoam agent and escapes as excess oxygen through the second #15 needle placed through the rubber stopper. Gentle rotation of the blood bottle after introduction of the hydrogen peroxide solution assures complete mixing. After 10 to 15 minutes all evidence of gas bubbles disappear. In the presence of catalase, warming the blood is unnecessary, since the optimal temperature for activity of this enzyme lies between 0°-10°C.[11] If antifoam agent is not employed, an overwhelming production of foam results and a geyser of blood issues from the needle vent.

Toxicity. In the absence of catalase, hydrogen peroxide irreversibly oxidizes hemoglobin to methemoglobin and protodent in a reaction that is toxic to normal oxygen transport.[12] Blood catalase is normally present in such excessive amounts, however, that the red cell is protected from irreversible oxygenation by the instantaneous conversion of hydrogen peroxide to molecular oxygen. Takahara[13] has shown that acatalasemia is a clinical rarity and that normal catalase concentration is far in excess of maximal needs.

Toxicity studies of the hydrogen peroxide-catalase mixture have, therefore, included evaluation of its hemolytic activity, of methemoglobin production, of the reversibility of erythrocyte oxidation, and in vivo tests in animals and in man.

The hemolytic activity of the hydrogen-peroxide catalase antifoam mixture was measured by adding graded amounts (0.1-2.0 ml) of the catalase-peroxide solution to fresh heparinized blood, so that the final volume totaled 12 ml. The mixture was allowed to stand 30-180 minutes at room temperature, centrifuged at 2,900 r.p.m. for 15 minutes and plasma free hemoglobin determined on a Lumitron colorimeter at a wave length of 530 mμ. Four samples of hydrogen peroxide oxygenated venous blood were thus serially diluted. Detectable hemolysis began at a 1/100 dilution of 3% hydrogen peroxide-catalase-antifoam mixture in blood (1 cc of 3% H_2O_2 per 100 cc blood). At the concentration utilized for complete oxygenation of a unit (500 ml) of banked blood the plasma free hemoglobin was consistently less than 25 mgm percent. It is evident that this method of blood oxygenation does not result in a serious degree of red cell destruction.

Methemoglobin concentrations were measured by the Evelyn-Malloy spectrophotometric technique[14] on a total of 8 separate heparinized samples of fresh human blood.

On each blood sample graded dilutions of from 0.1 ml to 2.0 ml of the oxidizing solution were added so as to make a final volume of 12 ml. There was no detectable production of methemoglobin in any of these samples, even when the oxidizing mixture was at a 1:6 ratio with the blood.

The reversible capacity for oxygen transport of erythrocytes so exposed to hydrogen peroxide and catalase was qualitatively demonstrated by bubbling CO_2 (750 ml/min.) through 100 ml of oxygenated blood, whereupon the oxygenated red blood returned to the dark color of venous blood. This was quantitated by measuring the oxyhemoglobin concentration of aliquots at varying periods during the reduction period on a Waters Conley oximeter.

In vivo toxicity studies with blood oxygenated with the peroxide-catalase-antifoam solution were first studied by the withdrawal of 150 ml of venous blood from eight mongrel dogs, oxygenation of the fresh samples, and reinfusion of the oxygenated blood. In no instance was there either early or late evidence of toxicity. In 4 animals reinfusion six weeks following the initial experiment produced no evidence of a sensitivity reaction to the beef liver catalase.

Ten patients have received 500 ml transfusions of blood oxygenated with the peroxide solution, and there has been no evidence of untoward reaction.

Volume of Oxidizing Solution Required. Hydrogen peroxide is an extremely rich source of oxygen. Two molecules of hydrogen peroxide yield one molecule of oxygen and two of water. Five ml of a 3% hydrogen peroxide solution will therefore produce 545 ml of gaseous oxygen at room temperature, which is theoretically sufficient completely to oxygenate 860-890 ml of venous blood.*

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*$2H_2O_2 \rightarrow O_2 + 2H_2O$

Venous blood contains 12-14 vol% O_2

Arterial blood contains 19 vol% O_2

Require 5-7 vol% O_2 for complete oxygenation of venous blood, or

5-7 ml O_2 per 100 cc blood, or

25-35 ml O_2 per 500 cc blood (1 unit)

1 gram molecular wt. of O_2 (32 grams) $\rightarrow$ 22.4 liters O_2

1 gram $O_2 \rightarrow$ 700 ml at 0° C. and 760 (22400/32)

1 gram $\rightarrow$ 763 ml at 25° C.

Require $\frac{763}{25} = 31$ ml of O_2 to oxygenate 1 unit venous blood at 12 vol%

$\frac{763}{35} = 22$ ml of O_2 to oxygenate 1 unit venous blood at 14 vol%

2 gram molecular wt. of H_2O_2 (68 grams) $\rightarrow$ 1 gram molecular wt. of O_2 (32 grams) $\rightarrow$ 22.4 liters

1 gram (or cc) of $H_2O_2 \rightarrow \frac{22.4}{68} = 335$ ml O_2 at standard conditions, or 364 ml at 25° C.

$\therefore$ Require $\frac{31}{364}$ grams of 100 % H_2O_2 or 0.085 ml to oxygenate 1 unit of 12 vol% venous blood

Quantitative studies on the actual volume of the 3% peroxide-catalase solution required to raise venous blood to complete saturation were performed on 5 samples of blood by serially adding 0.5 ml aliquots of the oxidizing solution to 250 ml of venous blood. Oxygen saturations were measured on the oximeter and standardized on the Van Slyke apparatus. Some of the samples of stored blood initially were less than 50% saturated and required 3.5 to 5 ml of the oxidizing solution per 250 ml of blood for complete oxygenation. Normally the addition of 2.5 ml would be adequate for 100% saturation.

For practical purposes it is best to add 5 ml of the oxidizing solution to 500 ml of stored blood, and then to see whether the blood has the bright red color characteristic of fully oxygenated blood. If not, 3.5 ml additional oxidizing solution can be added. If a full 10 ml charge is added in one injection, foaming becomes excessive, and can be avoided by the more deliberate addition of small volumes of oxidizing solution. This is more than three times the amount theoretically required but the system is neither 100% efficient nor is the oxygen saturation of stored venous blood reliably constant.

Discussion

Although hydrogen peroxide is an extremely potent oxidizing agent, and as such is highly toxic to living cells, it is the product of numerous biochemical reactions. Protection from such toxicity is afforded by the enzyme catalase which is present almost universally throughout the body, and which promptly degrades hydrogen peroxide to oxygen and water.[15] One molecule of catalase decomposes 2,600,000 molecules of hydrogen peroxide in 1 minute,[11,15] so that this toxic substance is instantly inactivated. The same protective mechanism for the erythrocytes is utilized in this method of blood oxygenation with hydrogen peroxide.

The toxicity studies indicate that there is a wide range of safety in the use of this oxidizing solution. More than an adequate supply of oxygen is provided by the addition of 5-10 ml of 3% hydrogen peroxide to 500 ml of blood, and such a concentration is far below that required to produce significant amounts of hemolysis or methemoglobin.

Although small amounts of oxygenated blood can be obtained by other techniques, such as wrapping the forearm for 20-30 minutes in warm packs, or by rotating the blood in an oxygen atmosphere,[16] these methods are not well suited to collecting or storing large amounts of blood. The use of hydrogen peroxide, catalase, and an antifoaming agent, on the other hand, could well be utilized in the preparation of large volumes of oxygenated blood.

Summary

1. The various uses for oxygenated banked blood have been described.

2. An easy, safe, and inexpensive method has been described for oxygenating banked venous blood by adding to it solutions of 3% hydrogen peroxide, catalase and an antifoam agent.

3. Both in vitro and in vivo toxicity studies have proven this method to have a wide margin of safety.

4. Possible applications of the technique are suggested.

Addendum

Since submitting this paper for publication our attention has been drawn to the neuro-toxic effects of small air bubbles in the cerebral circulation (Fries, C. C. and Dennis, C., et al., *Ann. of Surg.*, Vol. 145, No. 4, pg. 461, April 1957; J. V. Maloney, Jr., et al. *Surgery*, Vol. 42, No. 1, pg. 67-72, July 1957). Although there is no visible evidence of air bubbles after blood has been oxygenated according to this technique, further studies for late neurologic damage should be performed before the above de-

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$\frac{22}{364}$ grams of 100% H_2O_2 or 0.060 ml to oxygenate 1 unit of 14 vol% venous blood

or 2.8 ml 3% H_2O_2 (33.3 × 0.085) to oxygenate 500 ml at 12 vol%

2.9 ml 3% H_2O_2 (33.3 × 0.060) to oxygenate 500 ml at 14 vol%

scribed method is accepted for oxygenating blood.

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Preservation of Whole Blood by Freezing*

By
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OF ALL the commodities essential to the practice of military medicine, easily available, transfusable blood ranks high upon the list. The last two decades have seen significant advances toward this goal with the development of satisfactory methods for the routine storage of blood under refrigeration. Although the procedures for storing whole blood in ACD solution are simple and inexpensive, the expiration of such blood at the end of a three-week period leaves something to be desired, particularly in military situations where supply and demand are erratic. One of the major goals of blood banking is the development of a technique for the indefinite preservation of blood to permit stock-piling and prolonged transportation.

In the last few years, two methods for the low temperature storage of blood have been developed, both of which permit virtually indefinite preservation of red cells. One of these, discovered by Dr. Audrey Smith of England, requires a pre-treatment of the blood with a relatively high concentration of glycerine to prevent the otherwise inevitable destruction from freezing. The other technique, developed by Meryman and Kafig at the Naval Medical Research Institute in Bethesda, requires that the blood be frozen so rapidly that inadequate opportunity for injury exists. These two methods, although both utilizing low temperature storage, are otherwise totally distinct, operating on the basis of wholly different mechanisms. I will discuss these two techniques, both in regard to their mechanism of action and, what is perhaps of greater importance, attempt an evaluation of these two procedures in terms of their present and future potential.

Let us consider first the mechanism of freezing in cellular media and the manner in which injury to cells are caused. When a cellular biological medium is frozen, a curious and most significant phenomenon is observed; if freezing is slow, crystal formation is exclusively extracellular. The growing crystals remove water from both intra- and extra-cellular spaces, until the crystal has grown to a size perhaps many times that of the individual cell while the cells are compressed between them in a concentrate of their own solutes. Remarkable though this anatomical deformation may be, more remarkable yet is the histological recovery of these cells upon thawing. The cells reimbibe their water and appear apparently undamaged until autolysis commences. In fact, as well demonstrated in experimental frostbite, many tissues can even survive such treatment providing the exposure has not been of excessive duration, proving conclusively that ice crystal formation *per se* is not necessarily lethal. It has further been demonstrated that, where ice crystal formation is slow and extracellular, injurious effects do not result from the mechanical presence of the ice crystals but from dehydration and the concentration of electrolytes which inevitably results from the removal of water to form ice crystals. To repeat, in general, it is not the physical presence of ice crystals but the concentration of electrolytes that injures when freezing is slow and the ice crystals extracellular.

The curious tendency for ice crystals to form extracellularly is seen only when the rate of freezing is relatively slow, as, for example, when a specimen is placed in a conventional deep-freeze unit or even in air at dry ice temperature. When the rate of cooling is increased by immersion in a liquid bath at dry ice temperature or lower, the tendency for extracellular crystallization is overcome and crystals form at random

* Presented at the 63rd Annual Convention of the Association of Military Surgeons of the United States, Washington, D.C., Nov. 12-14, 1956.

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throughout the material, hence are predominantly intracellular. Obviously, an intracellular crystal is quite different so far as mechanical injury is concerned. The growth of a sizeable foreign body within a cell would not be expected to be easily tolerated. Remember, too, that despite the new location of the crystals the same concentration of electrolytes has taken place so that rapid freezing presents two mechanisms for cell destruction, denaturation from electrolyte concentration and mechanical destruction from intracellular crystals.

Now let us consider these two kinds of freezing, slow with extracellular ice crystals and rapid with intracellular crystals and examine means by which cell injury or destruction may be avoided. Following slow freezing, the injury results predominantly from electrolyte concentration and is a biochemical process proceeding at a definite temperature-dependent rate.

For blood, as Lovelock has so ably shown, hemolysis occurs rapidly when the salt concentration aproaches 4.7%, well before freezing has been completed. The only way of preventing this rapid hemolysis, then, is to reduce the amount of water removed to form ice and hence to reduce the salt concentration to an acceptable degree.

This is the basis of the glycerine technique. Glycerine has the ability to attach to itself considerable water which is then unavailable to form ice but can still act as a solvent. Glycerine also passes freely through cell membranes. Therefore the addition of glycerine to a specimen results in the binding of water and a reduction in the amount removed to form ice. The electrolyte concentration is therefore less and, if sufficient glycerine is added, is no longer lethal. This method has disadvantages. The glycerine must be removed following thawing of the specimen. This is at present difficult and time-consuming as well as necessitating the removal of the plasma and the preservation of washed cells only. The method has the advantage of being undemanding in the rate of freezing and thawing. Storage at temperatures from minus 40 to minus 80 degrees Centigrade appear to be low enough to prevent a rapid decay due to either excess glycerine or residual electrolyte concentration. Temperatures below minus 80 degrees Centigrade are necessary for good preservation in excess of a year.

If we are to attempt the preservation of blood through rapid freezing, a wholly new approach is necessary since the physical presence of intracellular ice crystals can be considered intolerable, and the only manner in which the cell may be spared the destructive force of the intracellular crystal will be to reduce the crystal in size until it becomes wholly innocuous. This can only be achieved by an extremeley rapid heat exchange, rapid enough, in fact, to supercool the blood to near minus 40 degrees before any appreciable crystal nucleation takes place, thus to achieve almost simultaneous nucleation and crystallization of every group of water molecules throughout the specimen. If we are to maintain this minute crystal size, we are also obliged to store the frozen material at a temperature sufficiently low to prevent the subsequent growth of crystals to a size which may be lethal. This temperature should be in the vicinity of minus 70 to minus 80 degrees C. for moderate periods of time and lower for very long term storage. Obviously, since damage from either crystal growth or denaturation occurs rapidly at higher temperatures, thawing must also be extremely rapid. In short, extremely rapid freezing, low temperature storage and extremely rapid thawing are the requirements for success with the rapid freezing method. Whole blood, frozen in this manner, shows fifteen to twenty percent hemolysis. Assuming that this results from the growth of some crystals too large to be compatible with cell survival, one of several materials capable of reducing the velocity of ice crystal growth may be added. The best of these for addition to blood appears to be glucose. Also efficacious are sodium citrate and urea. These compounds, added to produce final concentrations of between one and five percent radically improve the recovery of red cells. A concentration of 5% glucose can permit the recovery of 98% erythocytes or better.

Let us now consider the practical aspects

of these two techniques—how the procedure is actually carried out and what is the end product. Blood to be frozen by the glycerine method is brought to a 30 to 40 percent glycerine concentration by the slow and gentle addition of glycerine in isotonic sodium chloride solution. Following this, the blood is frozen slowly and is stored at low temperature. Most recent data indicate that a slow decay of red cells takes place at storage temperatures of minus 70 to minus 80 while only storage at temperatures below minus 80 can be assumed to provide relatively indefinite preservation. At the present, reconstitution is the major obstacle to speed and convenience in glycerine preservation. Not only must all the glycerine be removed but it must be removed slowly and gently to prevent undue mechanical or osmotic damage to the blood. This is currently done by centrifugation. The red cells are maintained in a loosely packed state while glycerine solutions of gradually decreasing concentration are flushed through them. This has been done using the Cohn fractionator and, more recently, with a modification of a conventional centrifuge. The time required to wash a pint of blood is in the vicinity of one hour. The washing process removes the plasma with the wash solution so that washed red cells only are recovered. There is a variable amount of red cell destruction during glycerinization and deglycerinization, ranging from as high as 50% to less than 10% depending on the care with which the processing is done. All free hemoglobin is, of course, removed during the washing.

For the rapid freezing of blood, glucose is added to whole blood to from one to five percent depending on the amount of hemolysis permissible. One percent glucose should permit about 92% recovery of cells while 5% should permit about 98% recovery of intact erythocytes. After addition of the glucose or other protecting agent, the blood is squirted through a fine capillary onto the surface of liquid nitrogen. It freezes in about a second and sinks to the bottom of the nitrogen from which it may be recovered in the form of a fine sand. Storage should be below minus 70 degrees C., preferably below minus 100 degrees for relatively indefinite preservation. Thawing is carried out by sifting the frozen material into warm saline or plasma. Only a small amount of saline or plasma is required to start the thawing, the total dilution for a pint of blood being about 10 cc's. Following thawing, the blood is ready for administration without removing the added glucose. All clotting factors and other plasma components are apparently unaltered. Leukocytes and platelets are also present but their viability is as yet undetermined.

To summarize: Glycerine freezing has the following advantages: The rates of freezing and thawing are undemanding and both procedures can be carried out under sterile conditions within a single bottle or plastic container. Although, for long storage, temperatures must be very low, brief exposures to higher temperatures can be tolerated such as might occur during transportation in dry ice or during brief power failure. The disadvantages lie primarily in the need for the removal of the glycerine which is time consuming and requires special equipment and handling. This in turn increases the possibility of hemolysing cells during manipulation or of increasing the percent of non-viable cells transfused. A final unfortunate result of the washing procedure is the loss of plasma.

The principal advantage of the rapid freezing method is that it provides whole blood. Nothing can as yet be said regarding equipment for the processing inasmuch as apparatus for sterile processing has not as yet been developed although this does not appear to be an overwhelming problem. In any case, special equipment will always be required. The disadvantages of the rapid freezing method are this need for special equipment and the demanding requirements for storage since although roughly the same temperature range is used as for glycerine preservation, even brief rises in temperature will result in rapid destruction of the blood.

As far as the future potential of these two preservation techniques goes it is quite conceivable that both can, in time, become far more practical for routine use than they are at present. Simple, automatic processing

equipment for rapid freezing appears reasonably probable and the same holds for the deglycerinization of glycerine-frozen blood. However, it does not appear at present as though there can be any way around the fact that equipment will be needed and that at least fifteen minutes to a half an hour will be required for reconstituting. At present, the addition of glucose for rapid freezing is mandatory although improvements in thawing technique may reduce or eliminate this in the future.

In any event, however, no matter how efficient or simple the processing of either glycerine or rapid frozen blood becomes in the future, it should be made clear that these methods cannot be considered a complete panacea for all problems of blood banking. The need for low temperature storage will always be a cost and nuisance factor to be reckoned with, particularly where really large scale operations are under consideration. There are, of course, areas where these preservation techniques are of obvious value: for the preservation of rare types of blood; for small banks at isolated locations; for red cell panels; plasma components that do not withstand preservation by other methods; and perhaps platelets, leukocytes or bone marrow suspensions. But glycerine or rapid freezing or, for that matter, any low temperature preservation technique should not be automatically assumed to portend a complete abandonment of the conventional methods of storing refrigerated blood. The benefit of glycerine and rapid freezing preservation lies in their ability to enable prolonged storage but this benefit does not come easily or cheaply nor can I forsee any prospect of either of these techniques being reduced in cost or convenience to a level fully competitive with the present three weeks refrigerated storage. The value of the low-temperature techniques lies in situations where long-term preservation is not merely convenient, but a necessity—a necessity sufficient to warrant the added complexity of additional blood handling. That the additional cost of indefinite preservation *will* be fully justified in many circumstances seems quite reasonable and a certain degree of optimism is surely warranted. We must take care, however, to be fully cognizant of the obstacles imposed by these low temperature procedures as well as their advantages and not permit the lure of indefinite preservation *per se* to blind us to many of the practical problems imposed. But practical problems aside, indefinite preservation has long been an unattained goal. It is reassuring to find that we now have at least two techniques which can do the job.

The Qualities of Leadership

By

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MUCH has been said and written on the subject of leadership but such discussions often are too loosely and superficially conceived. To be a leader, possession of moral integrity and a keen sense of ethical values is most important and well recognized. However, these are somewhat ethereal concepts which are subject to semantic interpretation. Let us approach the problem from the standpoint of appraisal of the qualities which you would expect to find in the person you would choose to follow. From the practical aspect, what qualities do you want in your leader?

First, you expect a leader to be fearless. He must not be afraid of his job nor for his job. He must be afraid neither of threats nor competition. He must not be afraid to make honest mistakes and must expect occasional honest mistakes in his followers. This type of fearlessness is found in one who knows his job well, knows what he wants to do and proceeds to do it. He is not insecure, vacillating and conciliatory. He must be able to say "no" when the answer should be "no" and continue to say "no" regardless of the consequences if he is right, realizing that it is never possible to say "yes" to everyone and since he cannot please everyone anyway, it is best to do what is believed to be right and be at peace with himself. Edgar Watson Howe said, "We are all so constituted by nature that no one can possibly entirely approve of us," and Shogun Ieyasu (1542-1616) summed this up by saying, "Find favor with thyself rather than with others." Abraham Lincoln in speaking of this quality of integrity said, "I do the very best I know how, the very best I can and I mean to keep doing so until the end. If the end brings me out all right, what is said against me won't amount to anything." He also stated that to sin by silence when they should speak out, makes cowards of men. Earlier Hippocrates had said that to hold opinions without putting them into action is a sign of want of education and a want of art. William Ellery Channing made this significant statement, "Whatever you may suffer, speak the truth. Be worthy of the entire confidence of your associates. Consider what is right as what must be done. It is not necessary to keep your property or even your life but it is necessary to hold fast your integrity." Many times professional men are reluctant to take a definite stand particularly in dealing with non-professional men or in situations where the professional man has accepted "employee" status, as in the military service. Vannevar Bush has covered both of these points very succinctly in this quotation, "Whether a man can be an employee and at the same time a truly professional man, depends upon whether he can maintain his individuality and his relative independence. Many can. The members of a profession minister to the people. To minister implies no servility, no apology, no inferiority. On the contrary, members of a profession minister with dignity, they demand the respect due their skill and devotion, they do not merely advise, they insist upon being heard, they do not submit their opinions for the judgment of the layman who is their client, no matter how powerful he may be, they insist that they have his confidence, that in their special field their opinion shall control or that he turn elsewhere." Benjamin Jewett, Master of Balliol College, expressed this concept more colorfully when he said, "Never explain, never retract, never apologize. Get the thing done and let them howl." All of these quotations reiterate the statement that a leader must be fearless.

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Next, you have a right to expect your leader to have knowledge, wisdom and experience. He should know most of the answers, say so frankly if he doesn't and then proceed to find out those answers. You don't want your leader to bluff or be bluffed, to be fooled or made a fool of. Equally important, your leader must know the limits of his responsibility and where the responsibility of others begins. Leaders who are always out of their field create constant turmoil and dissension. That knowledge and experience are priceless was well known to Hippocrates who said, "Ignorance breeds uncertainty. Inexperience is a stranger to confidence and joy and a nurse of cowardice and rashness. Cowardice indicates powerlessness; rashness indicates want of art." While occasional honest mistakes are expected, repetition of mistakes is not experience. On the other hand, we should not follow the man who is always right but rather the man who is least often wrong.

A follower wants his leader to believe in the importance of the work. This simply means that a leader must be sincere without a personal axe to grind, working neither for his own advancement nor for the advancement of some special interest or individual. A real leader accepts his work not only as a means but as a reason for living. One who works for the pay or prestige of the job misses the point entirely. Confucius said, "Rate the task above the prize," and this bears frequent repetition when so many are demanding their "just rewards" without sufficient thought of giving a substantial return. When a leader gets a kick out of his work, enthusiasm automatically is conveyed to those around him and it is truly said that every day is a holiday to a man who likes his job.

Next, you expect a leader to work hard at developing the capabilities of his subordinates. Surround yourself with capable people, work for their advancement and they will boost you up the ladder. A man should be called selfish not for pursuing his own good but for neglecting to aid in the advancement of his subordinates. Beware of the man who never has an understudy who can replace him. A man with competent and completely trained understudies always is available to advance to a higher position. You expect your leader to fight for you when you are right and to tell you what is what in plain terms when you are wrong—but in private. You want your leader to want you to succeed and you want him to be proud of you when you do—and to say so in public. A leader should recognize the human worth and dignity of those around him regardless of color, age, creed, family connections, social position or personal friendship. This is to say that a leader is loyal to his subordinates. This point often is forgotten and those in positions of leadership often stress publicly the need for loyalty to the boss but how frequently the boss forgets his loyalty to those around him. Loyalty, like cleanliness, is a near-divine attribute and instances where men turn viciously on individuals or groups with which they have been associated for many years are a shocking spectacle.

You have a right to expect your leader to be accessible and easy to deal with, predictable, calm and steady. You expect also that he will listen with undivided attention to what you have to present and will consider your presentation fairly according to its merits. A leader who can't be approached, who may throw an ashtray at you or greet you warmly by turns, who looks constantly at the clock while you are talking or consigns your unheeded presentation to file thirteen, cannot be considered as a mature rational being and is not a fit leader. Conversely, you cannot expect all of your ideas and projects to be acceptable to your leader. From his point of broader survey, there may be adequate reason for disagreeing with you. Here a frank statement of disagreement is in order and Napoleon said, "The people to fear are not those who disagree with you but those who disagree and are too cowardly to let you know." Prince Shotoku said, "Let us not be resentful nor look angry when others differ from us for each heart has its own

leanings. We are not unquestionably sages nor are they unquestionably fools."

A leader may be expected to understand those who work with him. You want him to be an absolute square shooter and to demand these same qualities in others. You expect him to hear gossip but not to be guided by it but rather to get his information at first hand. You expect constructive criticism and the mature individual will thank his critic, asking for suggestions for improvement. It is not always necessary for the leader to supply the answer, however, for as Ingersoll has said, "Although criticism should be as constructive as possible, it need not always be so for when you tell a man he has a counterfeit bill you are not obligated to replace it with a good one." No one likes to be criticized but people get ahead because they have strong points, not because they lack faults. If you would escape criticism, you must be satisfied to stay in the background because any action or even lack of action will offend someone.

Next, you want your leader to be willing to try new and hard things. Many men have made a career of saying, "It can't be done," but no progress ever has been made in this manner. A real leader says, "Don't tell me it can't be done; tell me how to do it!" Furthermore, reasons and excuses are needed very infrequently and usually are the crutch of weak men.

So far, we have mentioned only the positive aggressive characteristics of a leader and have not mentioned a most necessary trait—humility. You should expect a good leader to be humble, realizing his own limitations. It never is necessary to convince others of your worth, they usually can see it from your work. When your work speaks for itself don't interrupt. The boastful leader most often is trying to convince himself. Furthermore, when a man blames others for his failures, it is a good idea to credit others with his successes. Unfortunately, the stupid are cocksure and the intelligent are full of doubt. Another way of saying this is that genius has limitations whereas stupidity is boundless. It is said that nature couldn't make us perfect so she did the next best thing; she made us blind to our faults. None of us can develop all of the attributes mentioned herein but all of us can try, and the more of these qualities we develop, the better leaders and men we become.

EDITORIAL

Influenza

FEW persons in the Armed Forces today know through personal experience of the ravages of the terrible influenza epidemic of 1917-1918. Medical personnel in the fall of 1917 knew little of the power of the disease they were to fight in the camps and cities of our land.

In this issue of MILITARY MEDICINE we have reprinted in part an article on influenza which appeared in THE MILITARY SURGEON, the former name of our journal, Vol. 59, September 1926. We also give here the summary of an article by Colonel Deane C. Howard and Major Albert G. Love (now Brig. General, Retired) which appeared in THE MILITARY SURGEON (Vol. 46, May 1920) on the influenza epidemic of World War I:

"1. Influenza prevailed much more extensively in the Army in 1917 and during the early months of 1918 than has been commonly recognized. There were 40,512 cases of this disease reported in the Army for the year 1917.

"2. Unrecognized influenza was probably the primary and underlying cause of many of the atypical and fatal pneumonic infections occurring in the army camps during 1917 and the early months of 1918, in addition to the cases known to have been associated with measles.

"3. Influenza in 1917 and the early months of 1918 was relatively mild in type as compared with the virulent type of the disease which appeared in army camps in September 1918.

"4. The extension of the virulent influenza from Camp Devens to other camps south and west in September 1918 can be traced in many instances directly to the interchange of military personnel from infected to non-infected camps. The contagion was transferred by persons either themselves infected or who were carriers of the disease, and the extension definitely followed ordinary lines of travel.

"5. The height of the September outbreak of the disease in the United States extended over a period of about nine weeks (September 13 to November 15, 1918). During this period over 20,000 deaths occurred among troops in the United States alone in excess of the number that would have occurred if the disease death rate for the corresponding period of the preceding year had prevailed.

"6. The height of the epidemic in France extended over the same period of time as in the United States.

"7. Influenza and pneumonia were less prevalent and less fatal among our troops in France than in the United States.

"8. The "cantonment" group of stations gave a much higher death rate from influenza and its complication than other groups. (Tent camps or permanent posts.)

"9. For the entire Army (approximately 3,500,000 men) there were 688,869 admissions charged to influenza for the year, or 20 per cent of the command. This record does not represent the full incidence of the disease during this period.

"10. There were 47,384 deaths from all disease for the year 1918, of which 23,007 were attributed to influenza. In addition, 16,364 were due to pneumonic infections, bronchitis and pleurisy, many of which, it is certain, should have been charged to influenza, making a total of 39,371 due to acute respiratory diseases, or 82 per cent of the total deaths from disease for the year. Influenza with its complications is charged with 48.5 per cent of the total deaths from disease for the year.

"11. Influenza was more prevalent among white troops than among colored.

"12. White soldiers from the south had much higher admission and death rates for influenza, pneumonia and other acute respiratory diseases than white soldiers from other sections. The lowest rates for these diseases were among white soldiers from the Pacific coast and Rocky Mountain states.

"13. The negroes stationed in the United States had lower admission rates for influenza than the whites for the country at large, and much lower for these diseases than the whites from the south.

"14. The incidence rate for all forms of pneumonia, both primary and secondary, was nearly three times as high for the colored as for the whites for the entire country.

"15. The death rate for all pneumonic infections was more than twice as high for colored troops as for the whites.

"16. The case mortality for all pneumonia infections for the colored was about 20 per cent lower than for the whites."

Your editor who was a hospital orderly in the Army in the fall of 1917 saw some of these cases first hand. He was witness to a hospital commander's insatiable desire to get patients out of the hospital and he saw some of the results of the early dismissal from the hospital. The action was an error of judgment, of course, as shown days later by the return of these patients with the wet lungs of influenzal pneumonia which resulted in many deaths.

Today we are counting much on the influenza vaccine to prevent the disease since there is no chemotherapy for the virus at this time. The physician today is fortunate, however, to have medicines for the secondary invaders. Consequently we hope to prevent the empyemas which filled the hospitals for years after the 1917-1918 epidemic.

We hope that the Asiatic influenza will not be as successful in its morbidity and mortality power as the influenza of the 1917-1918 period. Lessons were learned then which should be re-taught now to the younger generation of medical personnel.

Around the World

(Ser. II, No. 14)

By
CLAUDIUS F. MAYER, M.D.

NORTHERN IRELAND was the experimental proving ground for a small trial of *immunization against poliomyelitis with live virus* (TN Type II of Koprowski, and SM Type I). A few adults, a few infants, and a number of older children susceptible to polio were fed TN and SM attenuated polio virus. In the majority of the children (77%) and in 22% of the adults, Type II antibody developed in response to the virus. In the SM series, all persons fed the virus developed Type I antibodies. At the same time, some of the virus could be detected in the stools of the group; in the excreta the TN and SM viruses regained their severely paralytic effect. Attenuated viruses as protective agents are expected to produce long-lasting immunity, while there is no evidence that the immunity with inactivated (Salk-type) vaccine will be durable. Attenuated viruses can be given by mouth, which is an advantage.

At a recent meeting of the British Red Cross Society, the Under-Secretary for Scotland discussed *Scottish health affairs.* Scotland is also in the hands of the British National Health Service, and she spent about 56 million pounds on the health service last year. Of the total number of 63,000 hospital beds, 40% are reserved for mentally ill and/or defective persons. Last year, the patients' traffic at the outpatient wards reached over 7 million. The great burden on the services is still the issue of spectacles and false teeth, though people had to pay for the dentures (since 1952). The *mortality of the middle-aged men* is the worst feature of the Scottish health statistics. There had not been any improvement in this report for the past 25 years. The chief causes of death among the middle-aged male Scots are coronary thrombosis and cancer, often lung cancer. It seems that their English brothers are better off, perhaps as a result of a more nutritious diet.

Among the factors which contribute to the *increase in mental illness in old age,* an English psychiatrist (Roth) mentioned: (a) the universal emphasis on the desirability of youth and of youthful middle age, and (b) the modern scale of values adopted by our urban civilization which measures the worth of people in terms of their earning capacity. Such an environment is not favorable for patients with coronary thrombosis or carcinoma. No wonder that under such circumstances the number of mentally deranged elderly people is steadily growing. In New York State, for instance, 2% of the entire population over 65 years are patients in mental hospitals.

British life-insurance medical officers have recognized that *life-cover* should not be fully denied *to substandard lives.* Once, it had been the practice to assess each such life individually, and to add the extra risk, in number of years, to the age of the applicant. This method, however, was not entirely satisfactory. Then, the substandard lives were segregated into large pools or groups. The first such pool was created in 1949 for diabetics. Another pool has been available for hypertensive persons since 1953. This year, *a coronary pool* was created. This pool accepts people who have occasional anginal attacks which do not incapacitate them, and persons who had had a single coronary thrombosis only. A study by American cardiologists (1956) showed that the average survival is at least 10 years for coronary patients. For myocardial infarction, a similar study showed 5-year survival for 81%, 10-year survival for 33%, 15-year survival for 14%, and 20-year survival for 5%. If the clinical recovery is complete, the 10-year survival is sure for 56% of the coronary cases. It was also found that heavy muscular build rather

than obesity was predisposing to the disease. A positive family history and heavy smoking are also claimed to lower the chances of long survival.

It is said that a single worker bee is able to collect 100 grams of pollen daily on its posterior limbs. At this rate, the total bee population of the U.S. would gather almost 80,000 tons of pollen daily. Many chemical studies investigated the *composition of pollens* which are used by bees. Most of them are rich in protides, amino acids, lipids, and vitamins of the B group. Recently, two French doctors succeeded in isolating an *antibiotic, a growth-promoting and a blood-sugar raising substance* from pollens. The antibiotic is the most abundant in the pollens of corn, chestnut tree, and dandelion. It can be extracted by boiling water. Its in-vitro action is strong against Proteus and Salmonella, but less strong against Coli bacilli and Pseudomonas. The growth-promoting substance is extracted by maceration of the pollen in water. It is abundant in the pollen of fruit-trees. In clinical trial, the pollen is said to make the intestinal function normal. In children's anemia it causes rapid increase in the hemoglobin values (honey does it, too!). Convalescent as well as aged patients quickly regain their weight and well-being. It is peculiar that the pollen collected by man is much weaker in action than the pollen collected by bees. It is said that the bee pours a drop of its intestinal content upon the pollen, and thereby puts the pollen under the action of its several diastatic enzymes.

In København, a physician and 86 military officers volunteered to test the effectiveness of a powder in the *treatment of contamination with mustard gas*. The powder was composed of Magnesia usta and Calx chlorata. The mustard gas was applied in solution to both forearms (a piece of wood was dipped in the solution, and the skin of the forearm was touched with it). If the powder was applied to the contaminated spot not later than an hour and a half after applying the mustard gas, blister formation at the site of application could be prevented.

At various parts of the world the belief is growing that explosions of *atomic bombs will influence the weather*. A report of the New York Academy of Sciences to the U.N. stated that recent deterioration of the weather may be the result of atomic explosions. Such a statement confirms the theory of DEBIERNE, member of the French Academy of Sciences, that the nitric acid formed during atomic explosions leads to condensations in the atmosphere which may remain for years and may influence the weather so that heavier rainfalls and numerous storms will develop. The atomic cloud of the explosion travels around the globe for about 22 to 25 days, in circles which come closer and closer to the North Pole. Several physicists are therefore almost certain that, for instance, the intensive cold of February 1956 was due to the atomic explosion on November 11, 1955. Karl BECHERT, biologist in Mainz, points out that the radioactivity of the atmosphere is still harmless for a while, but the *radioactivity of precipitation* becomes alarmingly great. Its effect upon the present generation is perhaps nothing, but its genetic effects are much worse. In connection with the influence of atomic explosions on precipitation it has been observed in Germany that the *hydrogen-ion concentration (pH) values of rain, dew and snow* became lower (i.e., shift to acidity). This has also caused a change in the pH values of the soil. It is well known that strong deviations in the acidity of the soil may cause damage to agriculture and fishery. (Since March 1956, all weather bureaus of the German Free Republic—at Bremen, Schleswig, Freiburg i.B., and Neustadt—are equipped to measure the radioactivity of air and rain).

In 1920, a German baron, a certain Freiherr von Pohl, came out with the theory that the *Earth emanates certain rays* which are harmful to all living beings. For the detection of these rays he later recommended the use of the so-called *divining rod*. His doctrine spread very rapidly, especially in the Central European states. There were a great

number of "diviners" thereafter who made it their business to detect the presence of earth rays, to extract them from the soil, and to sell protective apparatus against the ill-effect of the rays. Some of these apparatuses were just wooden boxes, with perhaps a piece of lead, wire, or an inkbottle affixed inside the box which was not supposed to be opened, lest the apparatus lose its mysterious power of protection. Now, in the Netherlands, many such devices were sold for the *prevention of diseases of plants and animals.* Owing to the uneasiness in scientific circles, the *Netherlands Academy of Sciences* started an investigation of the divining business, especially as it referred to agriculture. The three committees of the Academy, which had studied the Pohl doctrine of earth rays by scientific procedure, unanimously reported that earthrays injurious to life are non-existent; and that the advertised apparatuses have no power to control the mysterious non-existent rays. Whether the report of the Amsterdam Academy puts an end to the business of divination remains to be seen.

The signing of the Austrian State Treaty in 1955 made it possible to establish a very small *Austrian army.* One may wonder what kind of an army Austria can have which, by the treaty articles, is *a priori* denied the employment of trained and experienced staff officers. The first conscript group of recruits was called to duty in October 1956, but, according to the records of the Austrian physicians, at least one third of all youths in the draft age groups have some *physical defect* which makes them unfit for military service. Moreover, military service is very unpopular; young people always quote from such popular novels as *From Here To Eternity.* (The unpopularity of service comes partly from the fact that this is no more Kaiser Franz Josef's Army, and there is nothing stimulating in serving the intruding political parties and in defending a strategic nightmare, according to an American observer.)

There is much ado everywhere about the *drafting of low-intelligence (moron, etc.) youth in the armies.* Two military surgeons of the Zagreb District of the Jugoslav Army studied the problem since, at present, feeble-minded persons are considered fit for service in Jugoslavia. The training of such persons is always difficult, and it is very hard to assign them to adequate duties. Statistical records of military tribunals and psychopathic wards also show that many of the mentally defectives get into trouble with Army regulations and the Law. Hence, in the opinion of the Slavonian military doctors, imbeciles should be excluded from the Army, even in time of war. They could be employed in wartime labor brigades which are unarmed. Screening of the mentally defectives at the induction station is not an easy task. Yet, as soon as the signs of mental deficiency are suspected, the recruit should be thoroughly tested by such methods as the progressive matrix test, domino test, Frey culture test, etc., and he should be separated from the Army if he fails.

In such a country as *Turkey,* where infant mortality is high and thus the manpower is low, the *health and welfare of children* becomes of great importance. The Turkish government invited the World Health Organization to set up comprehensive maternal and child welfare services. Since 1954, a chain of health centers has been growing all over the country. Staffs are being trained in child welfare for the more than 500 health districts. The rural midwife service is also extended by the formation of a pool of midwife-nurse assistants (ca. 10,000 of them). A special school is planned for the training of inspectors and tutors, too. The school will be set up in Ankara this year.

Peptic ulcer is on the increase *in the Near East,* and the Middle East, as a physician of Lebanon recently reported. This statement is true for all the Arab countries in this part of the world. In Arabia, Egypt, and Lebanon, the ulcer is found mostly in the duodenum. It is strange that even among the ARAMCO people, coming from America to Saudi Arabia, ulcer is frequently observed. Is it in the climate? Or in the environment? The food of the ARAMCO people is American; their alcohol consumption is nil, on account

of the prohibition in Arabia; and financial worries are also absent. Thus, ulcer of the Near East often remains a mystery disease. Nevertheless, our western anticholinergic medicines (probanthine, belladonna) are still effective against the ulcer pains. Licorice preparations have also found favor.

It is almost unbelievable to read that there are still some 900,000 *Arab refugees* who had to leave their native land, Palestine, at the end of the Zionist War in 1948, and are now residing in Lebanon, Syria, Jordan, and the Gaza area; strangers and afraid in a world they never made. *Their health needs* are taken care of by the World Health Organization. Almost 50% of these people are living in 58 camps, while the others have settled in villages and towns. At the end of the fiscal year (June 1956), 3,368 health workers were employed for the service of Palestine refugees whose chief ailments were dysentery and eye diseases. The number of malaria cases dropped because many improvements had been made in environmental sanitation.

The *Baghdad Nuclear Training Center* opened at the end of March 1957. Its main purpose is to provide three or four courses on radioactive isotopes and their application. Some of the courses are devoted to the medical application of isotopes. The center also collaborates with the existing medical facilities on the introduction of radiosotopes for diagnosis and treatment. It will also help the Baghdad Museum, which is a rich collection of aniquities, in establishing the carbon-14 dating method in local archeological work.

The *food supply of the world* has its many problems and trouble spots. There are many measures taken to relieve chronic hunger. According to a recent agreement, Canada will deliver some 500,00 tons of *wheat to the USSR* in the coming three years. Most of the wheat is for Vladivostok and the Russian Far East which is not easily supplied *via* the Trans-Siberian Railroad. In Paris, a *society* was established for the study of *the technics of rain making* whose practical purpose is to relieve the African countries of the perpetual drought, and, thus, to increase local food production. Also in Paris, at a recent meeting, the former president of the UN Food and Agricultural Organization (FAO) and a French Abbé (Pierre) announced the creation of a new *World Association to Combat Hunger*. The aim of the Association is: (1) the creation of an international surplus of food reserves for the distribution to the hungry, (2) better exploitation of the sea as international source of food, and (3) training of experts to be sent to economically underdeveloped areas. In *Northern Rhodesia*, the government is worried about the meat supply; frozen meat had to be imported from Australia and New Zealand. Now, the local government is trying to *domesticate the buffalo* and the koudou antelope as possible future sources of meat.

The essential problem of the underdeveloped countries rests in the poverty of the rural population, and in the improvement of their living standard. In Asia, the problem is especially acute since the economy of that continent is based upon agriculture, agricultural employees representing about 80% of the entire population. Being chiefly an agricultural area, Asia puts itself into a status of *semistarvation*. Old fashioned methods of cultivation of the land cause the difference. With three hours of work an Asian farmer can produce only one Kg. of rice while an American farmer can produce 200 Kg. of corn during the same period of work. Not only the quantity but also the quality of the food products is of an inferior quality in Asia; at the same time the number of consumers is steadily growing.

No wonder that French doctors of the Academy of Medicine are worried that the next war will be a *bread war ("Guerre du pain") between East and West*. The Orient is eating by 25% to 40% less than the Occident. Thus, mankind finds itself in a "zone of alimentary pathology." There is just not enough produce of the land to feed the 2,700 million residents of the Earth, and the population is growing at a yearly rate of 40 million, according to the UN estimate. Our conflict with the East could lead to a terrible war which would not stop until 50%

of the food consumers would disappear. Eating of fruit and meat is a luxury for Asians. Even before World War II, 90% of the *Asian food calories* was from vegetables, and less than 10% from meat. After the war these figures shifted more. In Asia, 10% to 30% of the people have less than 1,500 calories per day. In 1951-52, the average consumption of calories was 2,160 in China, 1,600 in India, and 2,140 in Japan. The causes of this situation are: (a) unequal distribution of food, (b) low salaries and wages, (c) bad food politics. Perhaps much is due to custom. The *goat is a malediction of Islam;* where goats are bred, fertile lands become deserts. In Australia and Europe, it is *the rabbit* which does the land damage. Religious interdiction of *pork eating* deprives the Moslems and Jews of a great deal of protein. The same happens to the Hindu for his *reverence of the cow.* The situation is the worst in India where 9 out of 10 do not have enough to eat. The soil of India is the lowest in production. Having a 206-million bovine livestock (which is one third of the bovine stock of the entire world) the Hindus could stuff themselves fat and round, yet they do not kill the cow and they are satisfied with about 1½ quarts of poor milk per cow. The menace of the war can be fought by cultivation of virgin lands, change of certain substances into food, and avoidance of overpopulation in the East.

In regard to *overpopulation,* Japan has already taken some preventive measures. India is also doing the same. At a recent meeting of the *All-India Conference on Family Planning,* held in Calcutta, the establishment of more clinics and contraceptive centers was urged. Since metaxyohydroquinone is not very effective as an oral contraceptive, the West Bengal government opened a special Contraceptive Testing Center in Bombay. China is on its way to some similar arrangements. The Health Minister of China, who is a woman, announced the new policy of *legalized abortion in China.* It seems that this policy was decided upon only with great reluctance since there seems to be no other way to keep the more than 600-million population within the limits of the Chinese national economy.

China is a huge country, growing at a steady rate of 10-12 million a year. Once, the bad hygienic conditions, the various deficiencies, epidemics, floods, etc., acted as a natural brake upon the *terrifying growth of the Chinese.* Now, the mortality rate has decreased; there is no more infanticide practiced, and the death rate among the babies on the boathouses in Shanghai has been reduced from 50% to 2%. *Red China* has been eager to establish cultural ties with all parts of the western world. The present Chinese government uses every opportunity to invite scholars, students, professional men, artists and other people to whom the new growth of Chinese civilization and culture, rooting on the fresh ruins of millennial traditions, can be demonstrated through the official picture-window of Mao's red palace. An impressive portion of the Chinese new deal is devoted to the *health and medical affairs* of the mammoth Asian country. A group of Italian doctors, who had been recently led through a guided tour and inspection of medical China for 30 days, were favorably impressed not only by the progress which the Chinese made since 1949, the inauguration year of the communistic regime, but also by the hospitality of the Chinese Medical Association. (This Association now has a network all over China, with 43 regional and 268 local branches at different towns, including Huhohaot'en, provincial capital of inner Mongolia.) The Italians were guided through Peiping, Shanghai, Hang-Chow and Canton, familiar showplaces of the Far East, where they were given a glimpse at hospitals, medical schools, dispensaries, repair shops of medical instruments, drug factories, health resorts, even at the Health Ministry and Mme Li Teh-Chuan herself.

Being conducted on a prepared tour and not having the facility of the Chinese language, the guest doctors were unable to penetrate *behind the Chinese mask of politeness* or to study first-hand the health and medical

conditions anywhere else but at the places of the official display. Hence, their experiences represent but a small segment of the vast Yellow Empire, a tiny facet polished for western eyes. Nevertheless, some of the general free remarks of the Italians touring Red China are noteworthy. They felt, for instance, that there are *no flies in China,* neither in the hot cities of the South, nor in the trains running through rural areas for many hundreds of miles, nor in the villages of the peasants. This almost incredible sanitary improvement did not result from the use of insecticides but from the radically *changed attitude of the Chinese* toward personal and public hygiene and sanitation. Farmers now have clean fingernails, and the stokers of locomotives are wearing white gloves. (The policeman who directs traffic on the dusty streets of Peiping is protecting himself by wearing a surgical mask over his mouth.) With the flies have gone many other characteristics of Old China: the plague, cholera, smallpox, the brigandism, the child marriages, the sale of women, the habitual infanticide of female babies, even public prostitution, if we believe the medical sightseers.

There are now about 800 *hospitals in China,* almost twice as many as a few years ago. The number of beds has also increased in the hospitals. To quote an example, in a coal-mining town (Fushun), with about half a million inhabitants, 7 hospitals, 27 dispensaries, 44 maternity and child-welfare stations, and 42 first-aid stations in factories are active. It is curious how the ancient Chinese medicine and modern western medicine keep on existing and growing side by side, in harmony! Four-fifths of China is still seeking the *traditional Chinese methods of treatment* (including acupuncture, cupping, the use of herbs and animals, etc.), especially in the rural areas where no western medicine is usually practiced. In the institutions of modern medicine the directors are under official obligation to evaluate the therapeutic methods of the ancient culture. A small number of old-fashioned practitioners are members of the staff of every modern hospital where the cure of an ailment may start with measures of modern medicine, later to change to the traditional procedures, or vice versa.

The subject of the *Chinese medical schools* is not the science of medicine as such, but the medical student. Chinese universities instruct the students in the practical aspects and technic rather than in the science of medicine. About 30 university schools are now producing physicians for China. The medical schools themselves have five different faculties where one can graduate as a general practitioner, a pediatrician, a health officer, a dentist, or a pharmacist. Each faculty requires five full years of study for graduation (pharmacists study for 4 years). The number of medical students is limited according to the available facilities of the university.

Since the hospitals are mostly state or municipal institutions, or form a part of an industrial organization, and since medical treatment is free to every worker—7% of his salary is taken away for this purpose—many Chinese doctors are employees of the state and receive their salaries according to seniority, ancient or modern culture, and responsibility. *Private practice* is still permitted; yet, at the large medical centers, the private practitioners are at a disadvantage. Hence, they usually group together, to maintain a private dispensary which is more likely an expedient for their survival than an institution of high medical standards. In rural areas, the midwives are the advance guards of western medicine. In cities, each street is under the *sanitary surveillance* of some smiling woman who is always ready to exhibit her booklet where she records the pregnancies in her street, the number of children who have to go to school, the number of sick and hospitalized persons, the status of rat extermination along the street, etc.

Medical research in China is under the oppressive yoke of the "five-year plannings." Research is well paid, but it is little extant, and insignificant in content. A topic which

is suggested by the research worker has to be approved by the central organization of education and public health. Most topics deal with the practical problems of prevention and treatment of the socially important diseases. Much effort is spent on salvaging the ancient medicine, to the detriment of new pure research. The experimental approach echoes the Pavlovian theory of conditioned reflexes. Frankly, medical research in China is moving in the sign of the dogmatic and aprioristic science of Soviet Russia.

Thus, only a few Chinese institutions are able to come up qualitatively to the high level of western medicine. The *great medical centers* are actually continuing their work *in the western tradition* which they imbibed in the prewar years when these centers and hospitals were in the hands of Christian missionaries and of foreign concessions. There is, however, one great difference: it is the radical switch of these medical institutions from the service of foreigners to the benefit of the Chinese common people. The westernizing phase of China's development was followed by an eastern *renaissance of Chinese nationalism,* tinged though in the red paint provided by the "great" Soviet brother.

Red is even the dust which the Mongol wind is driving from the Gobi Desert to the doors of Peiping, and it penetrates everything. It settles on the sexless uniforms, on the trousers and coats of cotton in blue, and blue, and blue; on the millions of depersonalized Chinese who, spitting and coughing, walk on the dusty roads. Who can now foretell the fate of the seed of Western Medicine planted once in the sunny soil of Ancient China? . . . *Multa Paucis!*

Chinese Surgeon General Becomes Member of Our Association

MAJOR GENERAL YANG WEN TAH, Chief of Medical Services, Combined Service Forces of the Nationalist Chinese Army, has become a member of the Association of Military Surgeons of the United States. He was sponsored for membership by Captain Henry C. Henn, MSC, a Medical Advisor to the Chinese First Field Army, Taiwan.

(L to R) CAPT KENNETH A. OSTERBERG, MSC, USA; MAJ. GEN. YANG WEN TAH, Surgeon General; and CAPT. HENRY C. HENN, MSC, USA.

The General was born in Nan Chang City in Kiangsi Province in 1905. He received his medical degree from the Peking Union Medical College and joined the Chinese Army late in 1937. During World War II General Yang served as Surgeon of the Ninth and Third War Zones and at one time commanded the Kweiyan General Hospital. The General has been awarded the Armed Forces Medal, the Kwan Hua and the Hsin Li medals for his outstanding service.

Captain Henn reports that General Yang speaks excellent English without a trace of accent. The General attended the Advanced Course, Army Medical Service School, Fort Sam Houston, Texas, in 1952. He has sent a number of Chinese Medical Service officers to that School for training.

SUSTAINING MEMBERS

It is a privilege to list the firms who have joined The Association of Military Surgeons as Sustaining Members. We gratefully acknowledge their support.

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ASSOCIATION NOTES

Timely items of general interest are accepted for these columns. Deadline is 3rd of month preceding month of issue.

Department of Defense

Ass't Secretary (Health & Medical)—HON. FRANK B. BERRY, M.D.
Deputy Ass't Sec'y—HON. EDW. H. CUSHING, M.D.

PL 85-155

An Act to improve the career opportunities of nurses and medical specialists of the Army, Navy, and Air Force was signed by President Eisenhower on August 21, 1957.

The Act is divided into four parts: Title I (Army); Title II (Navy); Title III (Air Force); Title IV (Amendments).
Certain parts are abstracted here:

Title I (Army). Nurse Corps. The Chief of the Army Nurse Corps shall be a colonel, appointed for four years (not to be reappointed). The authorized strength for the Regular Corps is 2,500; five colonels, not more than 107 lieutenant colonels.

Medical Specialist Corps. The authorized strength for the Regular Army is 350. The Chief of the Corps is to be a colonel appointed for four years; not more than 20 lieutenant colonels are authorized.

Title II (Navy). "The number of officers serving on active duty in the grades of captain and commander in the Nurse Corps may not exceed, respectively, 2/10 of 1 per cent and 5 per cent of the number of officers serving on active duty in that corps."

Title III (Air Force). Nurses. The authorized strength is prescribed by the Secretary of the Air Force. Of that authorized strength for Air Force Nurses not more than five may in the regular grade of colonel, and not more than 107 may be in the grade of lieutenant colonel.

U. S. Army Photo

Studying the new law are COL. INEZ HAYNES (left), Chief Nurse; LT. COL. E. L. WADDELL (standing), DCS/Personnel; MAJ. GEN. SILAS B. HAYS, The Surgeon General of the Army; and COL. HARRIET S. LEE, Chief, Med. Spec. Corps.

Medical Specialists. The authorized strength is prescribed by the Secretary of the Air Force. Of that strength not more than one may be in the regular grade of colonel, and not more than 20 in the regular grade of lieutenant colonel.

AMERICAN REGISTRY OF PATHOLOGY DIRECTOR

Dr. Fathollah K. Mostofi has been appointed Scientific Director of the American Registry of Pathology of the Armed Forces Institute of Pathology. He succeeds Dr. Hugh G. Grady who resigned to become professor of pathology at the Seton Hall College of Medicine and Dentistry in Jersey City, N.J.

A native of Teheran, Iran, Dr. Mostofi attended the American College there for one year and came to the United States in 1931. He received his A.B. and B.S. degrees from

the University of Nebraska in 1935 and his M.D. degree from Harvard Medical School in 1939. After service with the Army Medical Corps between 1944 and 1947, he became a special cancer fellow at the National Institute of Cancer, Bethesda, Md., until he joined the Armed Forces Institute of Pathology in 1948.

Army

Surgeon General—MAJ. GEN. SILAS B. HAYS

Deputy Surg. Gen.—MAJ. GEN. JAMES P. COONEY

SGO ASSIGNMENTS

Col. Dean Sterling Beiter, DC, who was recently Dental Surgeon of the Third Army area, has been assigned as Chief, Dental Career and Assignment Branch, Dental Division, Surgeon General's Office. He replaces Col. Henry R. Sydenham, DC, who has been assigned to Letterman Army Hospital.

Col. Arthur P. Long, MC, has been appointed Chief of the Preventive Medicine Division in the Office of the Surgeon General.

Colonel Long entered the Army in 1941. He served in the Preventive Medicine Division of the Surgeon General's Office (1941-1944); was Assistant Chief, Preventive Medicine Division, Office of the Chief Surgeon, European Theater of Operations; Chief, Infectious Disease Control Branch, Preventive Medicine Division, Surgeon General's Office (1945-1947); Consultant in Preventive Medicine, Office of the Chief Surgeon, Far East Command (1948-1952). Before coming to his present position Colonel Long was Chief, Preventive Medicine Division, Sixth U. S. Army.

Col. Philip R. Beckjord, MC, has been appointed Assistant Chief of the Preventive Medicine Division, Office of the Surgeon General. Before this assignment Colonel Beckjord was Director, Division of Preventive Medicine, Walter Reed Army Institute of Research.

Lt.Col. Wendell R. Wilkin, MSC, has been appointed Chief of the Clinical Psychology Branch, Office of the Chief Psychiatry and Neurology Consultant, Surgeon General's Office.

Capt. Theodore B. Drotning, MSC, has been appointed Management Analyst to head the Office Systems and Services Section of the Hospital Methods and Improvements Branch of the Medical Plans and Operations Division in the Office of the Surgeon General. That Branch is responsible for developing the organizational structure of hospitals and dispensaries in the Continental United States.

TO FLAG RANK—RA

Recent promotions to the rank of brigadier general are: Thomas J. Hartford, Medical Corps, and Carl W. Tempel, Medical Corps.

General Hartford is Deputy Commander of the Walter Reed Army Medical Center, Washington, D.C., and General Tempel is the Commanding Officer of Valley Forge Army Hospital, Phoenixville, Pa.

PROMOTED TO FLAG RANK—USAR

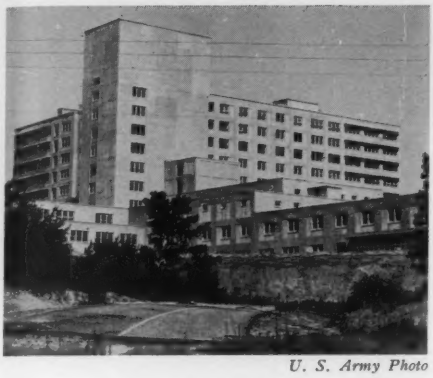
Dr. Thomas Fox, one of the nation's best known dentists and Philadelphia's civic-minded citizen, is the first member of his profession to serve as a dental officer in the status of brigadier general in the United States Army Reserve.

Dr. Fox is a civilian dental consultant to the Surgeon General of the Army. He is a member of the Civilian Health and Medical Advisory Council to the Assistant Secretary of Defense (Health and Medical).

MARTIN ARMY HOSPITAL

Fort Benning's modern five-wing, 500-bed hospital now under construction has been named the Martin Army hospital in memory of the late Major General Joseph I. Martin, Medical Corps, U. S. Army.

General Martin was a graduate of the Army Infantry School at Fort Benning and was known for his work in field medicine



U. S. Army Photo

MARTIN ARMY HOSPITAL
FORT BENNING, GA.

and his outstanding record in medical military education and training during a period of over 36 years of active service. During his service he was placed in many positions of great responsibility. Early in 1943 he became Chief Surgeon of the Fifth Army in North Africa, commanded by General Mark Clark. In 1945 and 1946 he served as Chief Surgeon of the Western Pacific and Chief Surgeon of General McArthur's Allied Forces in Tokyo. In 1947 he became Commandant of the Army Medical Service School, Fort Sam Houston, Texas. Following a tour of six years at that station he went to Germany as Chief Surgeon of the U. S. Army Forces, Europe.

The Martin Army Hospital will be completed early in 1958.

GOOD ADVICE

In a recent address at the Army Medical Service School Dr. Truman G. Blocker, Jr., Professor of Plastic and Maxillofacial Surgery, University of Texas School of Medicine in Galveston, had this to say:

"Military medical men learned the basis for better organization and self discipline, two essentials in caring efficiently for multiple injuries of any type of disaster."

Also, "Medical schools all over the country would do well to emulate the process of debridement of traumatic injuries taught at the school. And methods of casualty simulation, in which the school has pioneered in both research and teaching, are of invaluable assistance in presenting traumatic injuries to young medical students."

Further, "This is a very interesting period in which to be in the Army. High level Army policies and tactics are undergoing major changes, and the Medical Service must also make rapid adjustments to keep pace. You will learn the philosophy of both combat and civilian casualties during your period of active service.

"Individually, you will find that your Army service gives an unequaled opportunity to analyze and adjust yourselves. Even Army 'red tape' helps form more orderly habits. The advantages are many; seek them out rather than wasting your time in destructive criticism."

Dr. Blocker is Commander of the 807th Reserve Hospital Center in Galveston, and holds the rank of Brigadier General in the U. S. Army Reserve.

VISITS WRAIR

Dr. Ismail bin Dato Abdul Rahman paid a visit recently to the Walter Reed Army Institute of Research, Washington, D.C., and expressed the gratitude of the new Malayan government for the "very fine work and cooperation" of the Institute's Medical Research Unit Malaya which has been ac-

U. S. Army Photo

MAJOR HERBERT C. BARNETT points out a colony of mosquitoes from Kaula Lumpur, the Malayan capital, to DR. ISMAIL.

tively working in the Southeast Asian country.

At present the insect transmission of diseases and various Malayan fevers of unknown origin are being studied.

Dr. Ismail, an Australian-educated physician is Ambassador of the Federation of Malaya which became a self-governing dominion in the British Commonwealth of Nations on Aug. 31.

RETIRED

Brig. General Arthur L. Irons, DC, who has been in charge of Dental Activities at the Walter Reed Army Medical Center, Washington, D.C., was retired on August 31. He will be affiliated with Emory University, Georgia.

General Irons has been succeeded by Brig. General Clarence B. Canby, DC, formerly of Letterman Army Hospital, San Francisco, Calif.

MEAT AND DAIRY HYGIENE

At the Army Medical Service School, Fort Sam Houston, Texas, many courses are given. One of these courses pertains to meat and dairy products. Enlisted personnel are trained in inspection of these products so they can assist the veterinarians in their duties of providing wholesome food for the troops.

U. S. Army Photo

LT. COL. JAMES CRAWFORD, (left) demonstrated the stamps placed by the government meat inspectors of a side of beef.

U. S. Army Photo

An instructor at the Army Medical Service School is using a pork mannikin to point out the cuts of meat.

HONORED

Colonel James T. McGibony, MC, who is Surgeon of the Army Ryukyu Island and IX Corps Command, has been elected to membership in the Royal Society of Health, London.

VERDUN, FRANCE

"Sick call" at the 42nd Field Hospital in Verdun, Headquarters of the Advance Section, U. S. Army Communications Zone, took on a less plush, but equally efficient aspect recently, when patients found themselves en route from the dispensary to a fully-equipped field position, near Fort du Chana, outside Verdun, where the medics were rehearsing their combat role during a nine week field-training exercise.

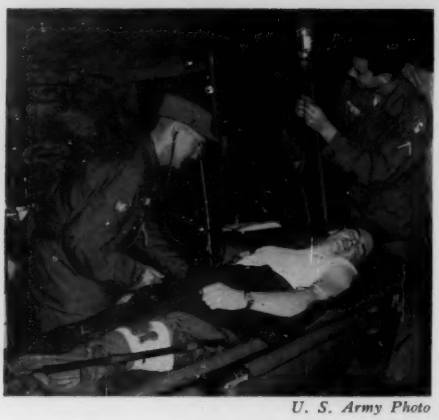
Instead of being called into the dispensary, examined, and treated on the spot, the patients were loaded into vehicles and carried the eight miles to the site of the field hospital where medics clad in combat uniform, utilized them to lend a touch of additional realism to their field exercise.

The field hospital included complete X-ray, pharmacy and treatment facilities, and ambulances and an Army helicopter, piloted by Capt. William R. Lynn, kept the medics supplied with patients.

The exercise, a rehearsal for an Army training test, was divided into three-week

U. S. Army Photo

Unloading the ambulance are (left) SGT. RICHARD L. WISMAN, SP-3 JAMES R. DEWEY, and PFC DAVID MONK (right).



U. S. Army Photo

A "seriously wounded patient," played convincingly by PFC CHARLES G. DAILEY, is prepared for a blood transfusion by SP-3 ROLAND J. SMITH (left) and PFC JOSEPH J. GENTILCORE.

training cycles, in which one third of the hospital personnel participated at a time. The training periods were divided into a week of classroom work, during which instructors from within the unit gave lectures and demonstrations, and two weeks of practical field work.

Under the supervision of Maj. Chester J. Kozlowski, commander of troops and unit training officer, and hospital commanding officer Lt. Col. Norman Lepper, the hospital continued to maintain permanent hospital and dispensary facilities within Maginot Caserne while also carrying out their mission under canvas in the field.

U. S. Army Photo

Two patients are brought into the 42d Field Hospital's training site by helicopter piloted by CAPT. WILLIAM R. LYNN.

ARMY GREENS

The date on which all officers and warrant officers in the active Army will be required

U. S. Army Photo

Facilities at the field site included a fully-operable X-ray unit, here being used on a patient by SGT. GAYLE H. COLLIER.

to own and wear the Army Green and the Army Blue uniforms is November 1, 1957. The officer's olive drab uniform (pinks and greens) may be worn by officers and warrant officers at their option until November 1.

There is an exemption for officers and warrant officers scheduled for separation from the active Army prior to the beginning of the 1958 summer uniform season or prior to May 1, 1958 in areas where the winter uniform is prescribed for wear the year around.

OFFICERS REVERTING TO NONCOMMISSIONED OFFICER RANK

Along with the stress on increasing the prestige of its noncommissioned officers, the Army has instituted several programs directed toward providing qualified enlisted personnel with improved opportunities for advancement. The previously discussed selected screening for reenlistments creates vacancies for deserving personnel. In addition, limitations placed on discharged commissioned officers reverting to the higher enlisted grades will help reduce the stagnation in noncommissioned officer promotions.

Formerly, non-regular officers relieved from active duty, in many instances, could enlist in grades E-6 or E-7 regardless of their individual qualifications and the Army's needs. A continuation of this policy would take away from promising young career enlisted men about 2,000 promotion spaces. Beginning 1 July 1957, only those officers who hold permanent warrants as Regular Army E-6's or E-7's may automatically revert to those grades. (From: Army Information Digest—Sept. 1957).

Navy

Surgeon General—REAR ADM. BARTHOLOMEW W. HOGAN

Deputy Surgeon General—REAR ADMIRAL BRUCE E. BRADLEY

PROMOTED

Edward C. Kenney, The Commanding Officer of the U. S. Naval Hospital, National Naval Medical Center, Bethesda, Maryland, has been promoted to the grade of Rear Admiral.

Admiral Kenney is a native of Ohio and entered the naval service in 1929. He was awarded the Navy Cross in December 1942 for extraordinary heroism as Senior Medical Officer of the *USS Boise* during action against enemy Japanese on the night of October 11-12, 1942, when the *USS Boise* took six separate targets under fire and sustained extensive damage from enemy fire, resulting in many casualties. None of the wounded died. He was Staff Medical Officer for Amphibious Group Three, Pacific Fleet at Guam, Leyte, and Lingayen Gulf.

RETIRED

Captain Ralph C. Parker, Jr., MC, U. S. Navy, who was Chief of Medicine at the Naval Hospital, National Naval Medical Center, Bethesda, Maryland, retired on September 1.

Dr. Parker will head a new experimental post-graduate medical education program to better patient care and to keep physicians in 31 member hospitals abreast of rapid developments in medicine, in his position as Director of Professional Affairs, Rochester Regional Hospital Council, Rochester, N.Y. He will also be on the staff of the University of Rochester School of Medicine.

Since Dr. Parker has been specially commended for performance of duty in combat he retired with the rank of Rear Admiral.

The following Medical Service Corps officers were retired on September 1: LCdr. Charles L. Alwin; LCdr. William E. Marsden; and LCdr. Guy A. Richard.

Captain Eric B. Hoag, DC, retired on August 1, 1957 after more than thirty years of service in the Navy Dental Corps. He had a distinguished and varied military career. He served with the Canadian Forces for two and a half years, during World War I. He also served for a year in the Royal Air Force, during which time he piloted a plane which sank a German submarine. He entered the U. S. Navy Dental Corps in 1926.

MEDICAL SERVICE CORPS CAREER INCENTIVES

In addition to the benefits which will accrue to officers of the Nurse Corps under the Public Law 85-155 signed by President Eisenhower on August 21 the status of Medical Service Corps officers is greatly improved by this important legislation. Features of the bill relating to the Medical Service Corps are:

1. The 2 per cent limit on the number of officers who may serve in the grade of Captain is repealed. Although no immediate promotions will result from this action because of the running mate principle, removal of the limitation will permit officers to attain eligibility for promotion with their line running mates. Under the former limitation most Medical Service Corps officers would never have promotion opportunity to Captain, because the limitation would have been reached before their running mates brought them into a promotion zone.

2. Medical Service Corps officers will serve as members of selection boards convened to recommend Medical Service Corps commanders, lieutenant commanders, lieutenants and lieutenants (junior grade) for promotion to the next higher grade. The law provides that one-third of the members of such boards shall be officers of the Medical Service Corps.

3. Women officers of the Medical Service Corps of the regular Navy may, upon application made not later than January 30, 1958, be reappointed in the Corps under the provisions of law applicable to male officers. Women officers of the Medical Service Corps of the Naval Reserve who were appointed before the effective date of this Act are now considered to have been appointed under the provisions of law applicable to male officers of the Naval Reserve. All officers so reappointed, regular and reserve, will retain their permanent grades and dates of rank, as well as accrued leave to their credit. Up to now, all women officers of the Medical Service Corps have been administered as WAVE officers under the Armed Services Integration Act, and have been subjected to the involuntary retirement dates and promotion limitations prescribed for WAVE officers. They may now become lineal list officers, with male running mates, thereby acquiring promotion opportunities at an earlier date, and to all grades up to and including Captain. The Chief of Naval Personnel will inform the women Medical Service Corps officers of the regular Navy of their opportunity for reappointment under the Act in time to permit their applications to be made before the deadline date of January 30, 1958. Women Medical Service Corps officers of the Naval Reserve will have their status changed administratively to that of lineal list officers without any action on their part.

Air Force

Surgeon General—MAJ. GEN. DAN C. OGLE
Deputy Surg. Gen.—MAJ. GEN. OLIN F. MCILNAY

NEW ASSIGNMENT

Col. Robert H. Blount, USAF (MC), has been assigned as Deputy Commandant of the Air Force School of Aviation Medicine, Randolph Air Force Base, Texas. Major General Otis O. Benson, Jr. is Commandant.

U. S. Air Force Photo

COL. ROBERT H. BLOUNT, USAF (MC)

Colonel Blount was Medical Air Attaché at the United States Embassy in Paris for three years. He is a native of Texas and a graduate of the University of Texas Medical Branch in Galveston. At the start of World War II he was ordered to Portland Air Base, Oregon and was chosen to supervise construction of the hospital at that station. The knowledge he has gained will be of great help on the new $10,000,000 installation for the School of Aviation Medicine now under construction at Brooks Air Force Base on the other side of San Antonio from Randolph.

ASSIGNMENT

Colonel Harold V. Ellingson, USAF (MC) has been appointed as Director of Plans and Training, School of Aviation Medicine, Randolph Air Force Base, Texas. He served as research assistant and instructor for six years at the University of Wisconsin prior to World War II when he entered the military service. He is a man of degrees: B.S., M.S., Ph.D., M.D., and M.P.H.

BALLOON ASCENT RECORD

Major David G. Simons, USAF (MC), a flight surgeon-pilot, soared to the height of 102,000 feet above the earth's surface on Aug. 19-20. The balloon ascension was made in Minnesota. He remained aloft for 24 hours during which time he collected valuable data which will later be useful in space flights of airplanes.

The height attained by Major Simons is 6,000 feet higher than that attained by any other manned balloon flight.

The doctor is in charge of the Space Biology Branch of the Aero-Medical Field Laboratory at Holloman Air Force Base, New Mexico.

CARBON MONOXIDE

A specimen of muscle from a pilot who was killed in an airplane crash was found to contain some green vegetation that had been imbedded by the violent impact of the crash. There was nothing so surprising about that except that the vegetation contained a surprising amount of carbon monoxide. No, the carbon monoxide had nothing to do with the death of the pilot.

What then? Dr. Syree S. Wilks, physiologist at the School of Aviation Medicine, Randolph Air Force Base, used the above information to investigate the presence of carbon monoxide in plant materials and found that the highest concentration in materials examined was in alfalfa. Enough carbon monoxide was extracted from a plant of alfalfa to asphyxiate mice. This gas was released only when alfalfa flour was exposed to sunlight in a container with water and oxygen. No carbon monoxide was released by healthy plants in their natural state.

All this information might conceivably be of value in space flight where vegetable matter might be aboard the space ship.

Public Health Service

Surgeon General—LEROY E. BURNEY, M.D.
Deputy Surg. Gen.—W. PALMER DEARING, M.D.

NEW POSITIONS

Dr. Otis L. Anderson, who has been Chief of the Bureau of State Services, U. S. Public Health Service, has been promoted to the new top-level post as Assistant Surgeon General for Personnel and Training. He has been succeeded in the Bureau of State Services by Dr. David E. Price, formerly Deputy Chief of that Bureau.

In this new position Dr. Anderson will have full responsibility for the development, manpower, utilization assignment, recruitment, and training activities related to personnel of the U. S. Public Health Service.

Dr. Price is a native of San Diego, California, and a graduate of the University of California School of Medicine and of The Johns Hopkins School of Public Health. He has spent all of his professional career in the Public Health Service. In 1950 he was named Associate Director of the National

Institutes of Health, and two years later, he was named Assistant Surgeon General in the Office of the Surgeon General. In March of this year he was named Deputy Chief of the Bureau of Medical Services.

PSYCHOPHARMACOLOGY SERVICE CENTER

A clearinghouse of information on psychopharmacology is being established by the Psychopharmacology Service Center of the National Institute of Mental Health. An extensive collection of the literature in this field, including pharmacological, clinical, behavioral, and experimental studies of the ataraxic, psychotomimetic, and other centrally acting drugs, will be classified and coded to enable the staff to answer a wide variety of technical and scientific questions. As soon as enough materials have been assembled the Center plans to offer bibliographic and reference service as well as the preparation of critical and analytic reviews of special topics in the field.

In order to accelerate the growth of the literature collection the Center invites persons working in this field to provide three copies of any papers that deal with their work—whether reprints, pre-publication manuscripts, progress reports, informal mimeographed reports, papers read at meetings, or abstracts. Letters outlining work in progress would also be welcome. Any restrictions that authors may wish to place on the Center's use of their papers will be strictly observed. All materials should be addressed to the Technical Information Unit, Psychopharmacology Service Center, National Institute of Mental Health, 8719 Colesville Road, Silver Spring, Maryland.

REACTIONS TO FLU VACCINE

Sensitivity to drugs and a great many other things is nothing new to the physician. So it is not surprising that there should be reports about the reactions of some to the Asian strain of influenza vaccine. These reactions are reported to be mild. The wise physician will keep the possibility of reactions in mind when giving any injection, whether it be influenza vaccine, penicillin, or anything else. Precautions should be taken for that one case in a thousand or even a hundred thousand cases where a reaction might occur.

In the case of influenza vaccine individuals should be questioned regarding an allergy to egg protein. Proper precautions must be taken by the physician when such an allergy is mentioned by the patient.

MEDICAL RESEARCH SURVEY

The Secretary of Health, Education, and Welfare has announced the appointment of a consultant's group to survey the medical research and education program of the country and its needs.

The chairman of the committee is Dr. Stanhope Bayne-Jones, former dean of Yale University Medical School and former Head of the Army's Medical Research Division, Office of the Surgeon General.

PROBLEMS OF AGED

A new research approach to the health problems of older persons was announced recently by the Surgeon General of the Public Health Service when $306,922 was awarded for research on aging to Duke University.

The program at Duke University has four main objectives: (1) to develop a Center for Aging Research based upon a University-wide effort; (2) to support fundamental research concerned with health problems of aging and to include relevant research contributions from the social and behavioral sciences and related fields; (3) to train investigators interested in the problems of aging; and (4) to foster a regional resource for the dissemination of scientific knowledge in the field of aging.

CANCER CELL DETECTOR

The Cytoanalyzer, a newly developed automatic optical electronic machine, has been installed at the University of Tennessee, Memphis, and will be used in connection with the cancer program of the National Institutes of Health.

The machine is designed to detect abnormal cells by microscopically scanning slides on which have been placed specimens from vaginal smears.

Dr. John R. Heller, Director of the National Cancer Institute, Bethesda, Maryland, has explained that the Cytoanalyzer is still in an experimental stage and needs further adjustment. He said, "We are hopeful that this will allow for millions of additional cell examinations without the training of thousands of additional persons."

Dr. George N. Papanicolaou, professor emeritus of clinical anatomy at Cornell University Medical College, has been a consultant on the project of the Cytoanalyzer and the Sloan-Kettering Institute performed some of the early research.

The Memphis project is concerned solely with cancer of the uterus.

RETIRED

The following Commissioned personnel have retired from duty with the Public Health Service, U. S. Department of Health, Education, and Welfare: Dental Director John A. Hammer, Medical Director Donald W. Patrick, Senior Sanitary Engineer Nelson H. Rector, Medical Director Henry C. Schumacher, Medical Director Lawrence H. Sophian.

Veterans Administration

Chief Medical Director—WILLIAM S. MIDDLETON, M.D.

Deputy Chief Med. Dir.—R. A. WOLFORD, M.D.

APPOINTMENT

Dr. John J. Blasko, former Connecticut Commissioner of Mental Health, was appointed Chief of the Veterans Administration Psychiatry Division. He has taken the position vacated by Dr. Stewart T. Ginsberg who has become Commissioner of Mental Health for Indiana.

VETERAN POPULATION

The veteran population in civil life at the end of June was 22,633,000. Of this number there were 5,105,000 with service in both World War II and the Korean Conflict; 15,332,000 with World War II service; 2,971,000 with World War I service; and 128,000 with service in other wars.

MEDICAL ADVISORY GROUP

Four new members have accepted appointment to the Veterans Administration Special Medical Advisory Group: Dr. Richard P. Stetson, Harvard University; Dr. John N. Robinson, Easton, Md., associate in surgery at the Squier Urology Clinic; Dr. Eugene P. Pendergrass, professor of radiology, University of Pennsylvania Medical School; and Dr. Robert H. Ebert, professor of medicine and chairman of the Dept. of Medicine, Western Reserve University School of Medicine.

OCCUPATIONAL THERAPY TRAINING

In order to increase the number of students in occupational therapy throughout the United States the Veterans Administration will accept more students in this field.

The training of these persons will be on a non-pay status; however they will receive quarters and subsistence for their services.

MALARIA CONQUEST

Of the hundreds of thousands of veterans who contracted malaria overseas during World War II and the Korean Conflict, almost none now requires treatment by the Veterans Administration for that disease.

The conquest of this disease among the veterans can be attributed to the drugs primaquine and chloroquine for the most part, but it has also been explained that the malaria parasite eventually "burns itself out."

RADIOACTIVE COUNTER

A total body radioactivity counter has been designed and developed by Dr. Gerald J. Hine, physicist in the radioisotope service of the Veterans Administration hospital in Boston.

Dr. Belton A. Burrows, chief of the service, said the counter marks a "break through

existing limits of radiation detection" and is the only one of its type in a hospital in this country.

This instrument is so sensitive it can measure the tiny amounts of radioactivity that are naturally present in the human body.

Miscellaneous

SOUTHERN MEDICAL ASSOCIATION

A new headquarters building for the Southern Medical Association was started on August 4 when the ground was broken for the $225,000 office building in Birmingham, Alabama. This Association was organized in 1906 and now numbers 10,000 members in sixteen southern states, the District of Columbia, Puerto Rico, Panama Canal Zone and the Virgin Islands.

FELLOWSHIPS AVAILABLE

Trudeau Fellowships in the field of tuberculosis and respiratory diseases are open to specially qualified candidates with an M.D. degree who have been assured of a continued teaching or research appointment upon completion of training. The fellowships are awarded for one year but may be renewed up to a total period of four years.

National Tuberculosis Association fellowships are available for candidates holding the degrees of M.D., Ph.D., or Sc.D., to make possible the continuation of graduate study in the field of respiratory diseases in an approved hospital or medical center. Such studies may be oriented toward teaching or research. These fellowships are granted for one year with a possible renewal for two more years.

For further information on these fellowships address: The Director of Medical Education, American Trudeau Society, c/o The Henry Phipps Institute, Seventh and Lombard Sts., Philadelphia 47, Pa.

LEUKEMIA

Dr. Harry A. Waisman, associate professor of pediatrics at the University of Wisconsin Medical School, has been awarded a $2,500 research grant by the Leukemia Society, Inc., to help support his research program on leukemia in children.

POSTGRADUATE COURSES

Current Trends in Gynecology is a postgraduate course to be given at The University of Texas, October 28, 29, and 30. For further information address the Postgraduate School of Medicine at that University, Texas Medical Center, Houston 25, Texas.

Arthritis and Allied Rheumatic Disorders (November 11-15), and *Peripheral Vascular Diseases* (November 18-22) are the titles of postgraduate courses to be given at the New York University-Bellevue Medical Center, New York.

BOOKLET AVAILABLE

Fat Content of Commonly Used Foods is a pocket size booklet with a brief non-technical discussion of "Dietary Factors in the Development of Atherosclerosis." The booklet is intended for patients; to be given to them by physicians. Copies of the booklet may be obtained free from Security-Connecticut Insurance Companies of New Haven, Conn.

ATOMIC ENERGY BOOKLETS

The Office of Technical Services, Department of Commerce, has a number of booklets available for sale on various subjects relating to atomic energy, protective devices, and measures to be taken against radiation. Address the above office, Washington 25, D.C., for list of booklets available and prices.

CARDIAC OUTPUT REPORT

Blood Volume and Cardiac Output Determinations, Using Radioisotopes, Report No. PB 121984, may be obtained from the OTS, U. S. Dept., of Commerce, Wash. 25, D.C., for $1.00.

MEETING

The 22nd Annual Convention of the American College of Gastroenterology will

be held at The Somerset in Boston, Mass., on October 21, 22, 23.

On October 24, 25, and 26, immediately following the Convention, Dr. Owen H. Wangensteen of Minneapolis, Minn., and Dr. I. Snapper of Brooklyn, N. Y., will again be the moderators of the Annual Course in Postgraduate Gastroenterology. The sessions will be held at The Somerset and in the Joslin Auditorium of the New England Deaconess Hospital. Attendance at the Course will be limited to those who have registered in advance.

MEETING

The American Public Health Association's 85th annual meeting will be held in Cleveland, November 11-15. Headquarters of this association are at 1790 Broadway, New York 19, N. Y.

PROPOSED CHANGES TO BY-LAWS OF THE ASSOCIATION

The Executive Council of the Association of Military Surgeons proposes certain changes in the By-Laws of the Association. These changes will be voted on at the Business Meeting of the Association to be held during the 64th Annual Convention, Hotel Statler, Washington, D.C., October 28-30, 1957.

CHANGE 1

Paragraph 5, Article VI, Section 3.

Present reading: "The accounts of the Secretary shall be audited by *an officer of the Finance Department of the Army or of the Bureau of Supplies and Accounts of the Navy, or* a certified public accountant as soon as possible after the end of the fiscal year *(September 30)* and at such other times as the Executive Council may require."

Proposed reading: The accounts of the Secretary shall be audited by a certified public accountant as soon as possible after the end of the fiscal year (June 30) or at such other times as the Executive Council may require.

CHANGE 2

Last sentence, Article XII, Section 6. (Retirement Plan Fund) "The fund may be invested by the Board of Trustees in *United States* Government Bonds *or in such other securities or deposits as are insured or guaranteed as to principal by the United States Government or a Government-owned Corporation, and yield a maximum interest rate consistent with reasonable safety and convertibility for payments,* or deposited in a bank or trust company until so invested or until used for the purposes of said fund." (The proposed amendment consists solely of the addition of the words in italics above.)